NASA CR-169,537

NASA-CR-169537
19830005751

A Reproduced Copy

OF

Reproduced for NASA

by the

NASA Scientific and Technical Information Facility

LIBRARY COPY

MAR 2 8 1983

LANGLEY RESEARCH CENTER
LIBRARY, NASA
HAMPTON, VIRGINIA

FFNo 672 Aug 65

Return to E Hamilton NHS-2

(NASA-CR-169537) GOVERNMENT FINANCIAL SUPPORT FOR CIVIL AIRCRAFT RESEARCH, TECHNOLOGY AND DEVELOPMENT IN FOUR EUROPEAN COUNTRIES AND THE UNITED STATES Final Report (Operations Research, Inc.) 93 p G3/84 15250

N83-14022

Unclas

ORI

N83-14022

ORI
Silver Spring, Maryland 20910

GOVERNMENT FINANCIAL SUPPORT FOR CIVIL AIRCRAFT RESEARCH, TECHNOLOGY, AND DEVELOPMENT IN FOUR EUROPEAN COUNTRIES AND THE UNITED STATES

FINAL REPORT

BY: B. CHANDLER, R. GOLASZEWSKI,
C. PATTEN, B. RUDMAN, R. SCOTT

AUG 1982
RECEIVED
NASA STI FACILITY
ACCESS DEPT.

1 APRIL 1980

PREPARED UNDER CONTRACT No. NASW 2961
TASK ORDER No. 42
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

AUG 1982
RECEIVED
NASA STI FACILITY
ACQ BRANCH

PREFACE

This report concerning governmental expenditures for commercial airframe and engine research and technology by the United States and four European countries has been prepared jointly by ORI, Inc. and Gellman Research Associates, Inc. in response to Task 42, NASA contract NASW-2961, for the Office of Aeronautics and Space Technology, National Aeronautics and Space Administration.

TABLE OF CONTENTS

TABLE OF CONTENTS
(CONT.)

LIST OF TABLES

EXECUTIVE SUMMARY

The purpose of this report is to provide the National Aeronautics and Space Administration (NASA) with data on the levels of government financial support for civil aircraft airframe and engine (CAAE) research and technology (R&T)[1] in the United States and Europe (United Kingdom, West Germany, France and The Netherlands), and to provide means of comparing these levels.

Data are presented for the years 1974-1977. European R&T expenditure data were obtained through visits to each of the four European countries, to the Washington office of the European Communities, and by a search of applicable literature. CAAE R&T expenditure data for the United States were obtained from NASA and the Federal Aviation Administration (FAA).

In contrast to the United States, major portions of the European aerospace industry have been nationalized. The British Aerospace Corporation, formed in April 1977, marked the consolidation and nationalization of the

---

[1] Research and Technology (R&T) as used by NASA is the conduct of research directed toward advancing technology. Other Federal agencies engage in Research and Development (R&D) activities which generally consist of basic and applied research plus several phases of development. NASA R&T could be compared to the basic and applied research phases and exploratory development phase of R&D. Exploratory development is defined as post-research efforts directed to the solution of specific problems short of full development.

British Aviation Industry. The Rolls Royce engine company was nationalized in 1971. The French history of aerospace consolidation and nationalization continued with the formation of Aerospatiale (SNIAS) in 1970. SNECMA, France's major civil engine manufacturer, is also nationalized. West Germany and The Netherlands have provided major financial support to their aerospace industries.

The governments of all these countries have also traditionally provided support for aeronautics research and technology, as has the United States. In addition, considerable European government funding has been devoted to the development of specific civil aircraft and engines, whereas U. S. government funding has not. This report considers only civil aircraft airframe and engine R&T expenditures. Table ES-1 presents this data for the United States and for each of the four European countries.

Expenditures for CAAE R&T by the United States averaged $268.7 million per year over the four year period compared to an average annual combined expenditure of $100.7 million by the four European countries. While this comparison of the absolute value of average annual R&T expenditures reveals a U. S. government expenditure 2.7 times as much as the four European governments combined, it does not necessarily indicate that this expenditure is disproportionate. There are several ways of comparing U. S. and European government expenditures for civil aircraft airframe and engine R&T:

- In relation to the size of the economy in the countries
- In relation to total Government expenditures for R&D
- As a percent of civil aircraft sales
- In relation to the demand (need) for air travel.

Other factors to be considered when comparing civil aircraft airframe and engine R&T expenditures include the size of the civil aviation industry in relation to the demand (need) for air travel and the importance of civil aviation to the economy of the country. These comparisons, shown in Tables ES-2 and ES-3, are discussed in the following paragraphs.

TABLE ES-1

U.S. AND EUROPEAN EXPENDITURES FOR CIVIL AIRCRAFT AIRFRAME AND ENGINE RESEARCH AND TECHNOLOGY ACTIVITIES, 1974-1977

($ millions, 1977 prices)

Country	1974	1975	1976	1977	Average 1974-1977
United Kingdom	41.0	36.4	29.8	34.1	35.3
France	25.0	29.3	29.5	28.7	28.1
West Germany	23.9	20.9	24.1	27.6	24.1
Netherlands	11.8	12.6	13.4	14.8	13.2
Total: Four European Countries	101.7	99.2	96.8	105.2	100.7
United States	279.8	259.1	265.8	269.9	268.7

TABLE ES-2

COMPARISONS OF U. S. AND EUROPEAN GOVERNMENT
EXPENDITURES FOR CIVIL AIRCRAFT AIRFRAME AND ENGINE (CAAE) R&T

		U. S.	Four European Countries
1	$\frac{\text{Average Annual CAAE R\&T}}{\text{Average Annual GDP}^1} \times 100$	0.02%	0.01%
2	$\frac{\text{Average Annual CAAE R\&T}}{\text{Average Annual Total Gov't R\&D}^2} \times 100$	1.22%	0.74
3	$\frac{\text{Average Annual CAAE R\&T}}{\text{Average Annual Civil Aircraft Sales}} \times 100$	2.97%	3.70%
4	$\frac{\text{Average Annual CAAE R\&T}}{\text{Average Annual Total Airline Traffic}} \times 1000$	$1.2[3]	$1.5[3]

[1] Gross Domestic Product (GDP)

[2] Research and Development (R&D)

[3] Dollars per thousand passenger kilometers

TABLE ES-3

COMPARISONS OF CIVIL AERONAUTICS INDUSTRY SIZE
AND COUNTRY NEED FOR CIVIL AERONAUTICS

		U.S.	Four European Countries
1	$\frac{\text{Average Annual Civil Aircraft Sales}}{\text{Average Annual Total Airline Traffic}} \times 1000$	$40.00[1]	$42.00[1]
2	$\frac{\text{Average Annual Civil Aircraft Sales}}{\text{Average Annual GPD}^2} \times 100$	0.50%	0.24%

[1]Dollars per thousand passenger kilometers

[2]Gross Domestic Product (GDP)

ORIGINAL PAGE IS
OF POOR QUALITY

The first ratio in Table ES-2, a comparison of CAAE R&T expenditures to the size of the overall economy, expressed as Gross Domestic Product (GDP), shows the United States spent twice as high a proportion of GDP for CAAE R&T as the European countries (0.02% to 0.01%). However, this measure makes no allowance for the size of the industry in Europe or the United States.

The second ratio compares average annual CAAE R&T expenditures to the average annual total government research and development (R&D) expenditures. This ratio provides an indication of the relative emphasis on CAAE R&T in the overall government R&D program (of which civil aeronautics R&T is a small part). This ratio for CAAE R&T in the United States is 1.6 times greater than the corresponding ratio in Europe.

The third ratio in Table ES-2 is an investment to output ratio, showing the relationship of average annual CAAE R&T expenditures to average annual sales (in 1977 dollars) of civil aircraft. This ratio shows that the four European countries provide about 1.2 times more government R&T support in proportion to their civil aeronautics industry than the United States. The last ratio in this table, government investment in civil aircraft airframe and engine R&T to passenger kilometers flown in the United States and Europe, is a reflection of the R&T investment in relation to the demand for civil aviation. The U. S. investment in CAAE R&T is slightly less than the European expenditures in dollars per thousand passenger kilometers flown (1.2 to 1.6). This indicates that when the needs for civil aviation are taken into account, the European governments provide a greater level of support for CAAE R&T than the United States.

Other normalizing ratios were developed that used broader gages of industry size and a country's need for civil aviation. The civil aeronautics industry size in the U. S. and Europe is related to average annual civil aircraft sales, and the "need for civil aviation" is expressed in average annual total passenger kilometers flown. Two ratios using these indicators are shown in Table ES-3.

The first ratio, Average Annual Civil Aircraft Sales to Average Annual Total Airline Traffic, or size to need, shows that civil aircraft sales per passenger kilometer flown are almost equal. Therefore, the output of the European industry and U. S. industry is in the same proportion to passenger kilometers flown, or in other words, the size of the industry is compatible with the need for civil aviation in both Europe and the United States.

ORIGINAL PAGE IS
OF POOR QUALITY

The second ratio of civil aircraft sales to GDP is used to control for industry size. This measure indicates how important the civil aeronautics sector is to the economy or how much of the GDP is accounted for by the output of the civil aeronautics sector. The United States civil aeronautics industry contributed twice as much to the U. S. GDP as did the industry in the European countries. Therefore, when controlling for industry size, the two to one ratio of R&T to GDP is more clearly understood.

Conclusions

1. In absolute terms during the period 1974-77 the United States government contributed 2.7 times more dollars for civil aircraft airframe and engine R&T than the combined total for the four European countries.

2. When the size of the aeronautics industry in the United States and Europe is put into perspective, and the need for civil aviation is accounted for, government expenditures on civil aircraft airframe and engine R&T in the United States and Europe are not disproportionate.

I. INTRODUCTION

BACKGROUND

This report, "Government Financial Support for Civil Aircraft Research, Technology, and Development in Four European Countries and the United States" was prepared for NASA jointly by ORI, Inc. and Gellman Research Associates, Inc. (GRA). The purpose of this report is to provide NASA with information on the level of financial support provided by the governments of France, Great Britain, West Germany, and the Netherlands for research and technology (R&T) in civil aircraft, airframes, and engines. This report divides expenditures into two categories: research and technology, and program development. For the purposes of this report, development expenditures are those which are applied to a specific project (e.g., A-300, RB-211, etc.). Research and technology expenditures are those which fall under the general heading of research not intended for a specific program. The European information is aggregated and is then related to United States expenditures in the civil aeronautics area.

SCOPE

Expenditure information is presented for the years 1974 to 1977 for each country and for those expenditures relating to civil airframe and engine research, technology, and development. Most information was developed

through the use of publicly-available documents. In a few cases, information obtained from interviews was used to disaggregate gross expenditure data to a level of greater detail. The study does not consider expenditures for research intended primarily for military applications which may also benefit the civil sector.

METHODOLOGY

The work for this study was begun in 1978. At that time, NASA requested that all information used in this study be from public sources. The initial step in the work program, therefore was to conduct a thorough literature search.

This consisted of:

- a literature search of a computerized data base,
- review of trade periodicals,
- review of official publications of the four European governments.

The study team, through its subcontractor in England, INSPEC, also contacted government and industry officials in the study countries to obtain access to official budget documents.

A GRA staff person was then dispatched to Europe to work with INSPEC in the data-gathering effort. Each of the four countries was visited, and documents were obtained from official sources. Where necessary, INSPEC conducted interviews with officials of the four governments to obtain more detailed explanations when the documents were not clear.

All information was transmitted to GRA for preparation of reports. The currency in which each country's financial data were reported was converted into equivalent U.S. dollars for the year of expenditure (as reported in Chapter 3).

Information was then developed regarding the historic role of government in the aerospace industry for each country examined in this report. This portion of the analysis concentrates primarily on the last fifteen years, and also presents an overview of the recent collaborative efforts of these European countries on major civil programs.

After the data had been organized and preliminary reports furnished to NASA, it was decided that the report should focus on the areas of research and technology expenditures as these most closely correspond to the activities in which NASA is engaged. No analysis was made of the expenditure data for government support of the development and marketing of specific aircraft types in light of the mandate from NASA for this study. Using data furnished by NASA and FAA on U.S. funding of civil airframe and engine research and technology, several comparative analyses were performed. The major purpose of these analyses was to determine if the expenditures of the four European countries were disproportionate to the governmental support provided in the United States. In order to present valid comparisons, all financial data are stated in 1977 prices.

II. THE ROLE OF GOVERNMENT IN THE EUROPEAN AEROSPACE INDUSTRY

BACKGROUND

The direct support that European governments provide to their civil aerospace industries has been critical to the viability of those industries in the last decade. This support has been rendered to a degree not found in the United States. Many European governments that have extended considerable finanical assistance to their civil aerospace industries have formulated policies mandating--or, at the very least, strongly encouraging--industry rationalization which they consider essential to efficient operations and to marshal the large-scale resources needed to compete with the United States. The government's support and intervention have been justified by (1) the importance of the civil aerospace industry to the achievement of full employment and the maintenance of high levels of technology and export earnings, and (2) the very high financial requirements of recent civil aerospace programs--requirements which have taxed the resources of even the largest U.S. firms (and European aerospace firms have always been significantly smaller than their U.S. counterparts).

This study is concerned with a transition period in the evolution of the European aerospace industry, the years 1974-1975; the ultimate possible outcome, EEC sponsorship of a fully integrated European civil aerospace industry, has not yet been reached. European governments are still actively designing national aerospace policy. It is the purpose of this chapter to

examine the role of the government in the aerospace industry as well as the intra-industry consolidation which has taken place in the United Kingdom, France, the Federal Republic of Germany and, to a lesser extent, the Netherlands. This will serve as a necessary background against which to relate the detailed figures presented in Chapter 3, documenting the financial assistance received by aerospace industries in the four countries under study. A brief overview will also be given of recent efforts at European collaboration. For the purposes of this report, only those firms engaged in major civil airframe and engine programs will be discussed.

UNITED KINGDOM

The inauguration of the British Aerospace Corporation on April 29, 1977, marked the end of a lengthy period of uncertainty during which the British Labor government had planned the nationalization and subsequent corporate restructuring of the British aviation industry. Three major groups--the British Aircraft Corporation, Hawker Siddeley Aviation, and Hawker Siddeley Dynamics--plus Scottish Aviation were merged into one aerospace complex, the logical outcome of a trend towards consolidation which had begun in the aviation sector several decades earlier. At the end of World War II, there had been as many as 70 private firms in the British aviation industry.[1]

The nationalization of the country's leading airframe manufacturers had been under consideration for many years. The Conservative party, when last in power, had decided that some concentration of resources was necessary if the British aerospace industry were to survive. When the Labor government came into office in February 1974, the nationalization concept was proposed in terms of one huge corporation. It would have included the Rolls Royce Company, which had become a nationalized company in 1971.* It soon became clear, however, that the engine manufacturer would encounter serious difficulty selling engines in a highly competitive international market as part of a large airframe complex.[2] Rolls Royce was, therefore, left independent.

---

*The Conservatives would have wanted to put part of Rolls Royce back into private shareholding as well as concentrating airframe and missile activity under privat ownership.

A major reason for the proposed nationalization was the belief that it would permit the best possible use of overall available resources[3]. Full public ownership was considered more effective in achieving this goal than earlier reorganization plans based on either fully private ownership or partial government shareholding. Additional factors cited included (1) greater public accountability in an industry depending to an unusually great degree on government purchasing and financial support and (2) greater flexibility in industry operations when cooperating with both government-owned and privately-owned industries in other countries.[4] The outlook for future projects made it improbable that two main competing companies, the British Aircraft Corporation and Hawker Siddeley Aviation (Hawker Siddeley Dynamics is a missile group), could maintain profitable operations as they were organized; public ownership would permit changes in structure to be made "with the speed which the interests of the industry and the nation required."[5]

An additional provision in the proposed legislation would also allow the new corporation to acquire, by agreement, other companies still privately held if this was found mutually advantageous.[6] The plans called for vesting in the new corporation shares of any company whose turnover exceeded $48 million the previous year. An exception was made for Scottish Aviation which was included in British Aerospace.

Civil research and development will continue to be financed from the corporation's general funds. If government assistance is needed for a particular project, undertaken for "wider national reasons," then this assistance is separately provided and accounted for.[7] New military contracts continue to be carried out under contract with the Ministry of Defense. The corporation itself is financed by loans on normal terms from the National Loans Fund and by public dividend capital (a form of government-owned equity made available to nationalized industries which are basically profitable but subject to cyclically fluctuating returns).[8] British Aerospace answers directly to the Secretary of State for Industry, who not only appoints the firm's Chairman and Board, but also approves the annual corporate plan, capital investment, the operating budget, and research and development programs. The Secretary also approves any major new development projects--except military projects undertaken for the Ministry of Defense.

The restructuring was not entirely smooth; during negotiations the British Aircraft Corporation and Hawker Siddeley had to consult with the Secretary of State if expenditures affecting the ultimate value of the company were to be made. Requests for guidance piled up, many of which had to be referred to the Ministry of Defense because the Department of Industry had little experience in aerospace.[9] A continuing difficulty in the present situation is that, apart from the Concorde project and Rolls Royce engines, the Department of Industry has little power to make decisions and fund projects with respect to actual hardware.[10] The Ministry of Defense remains the main contractual organization, also controlling key research centers such as the Royal Aircraft Establishment and the Royal Radar Establishment.[11] Despite huge government investment in the Concorde and the sharing of development costs for two other civil aircraft, the military field continues to enjoy the major share of research and development funding.[12]

The ultimate outcome of nationalization cannot yet be determined. The Conservatives continue to stress that upon return to power they will denationalize the industry.[13] There is no doubt that maintaining employment levels is a high priority objective of the British government, particularly in an industry where a highly skilled work force and national pride are significant factors. However, nationalization is not expected to support the duplication of design teams and staff involved in the consolidation of the two separate firms. Furthermore, maintaining current employment levels will depend upon improvements in the outlook for new projects--this despite the record levels achieved by British Aerospace exports in the mid-1970s.[14]

Nationalization has helped certain companies. In 1971, for example, the British government intervened to prevent the almost certain bankruptcy and disappearance of Rolls Royce, a major company in this sector, employing 65,000--a number almost equaling the work force of the major airframe and missile companies combined.[15] The British government's decision to provide funding for the installation of th RB-211 in Boeing's 747 was a major boost to the engine manufacturer, as was its more recent decision to permit British Airways to purchase the proposed Boeing 757 with Rolls engines. This relationship with the British government makes firm government decisions crucial with respect to future investment (e.g., how much money should be spent on engine development programs).

The future of the British Aerospace Corporation is closely allied with the course of aerospace policy and financial support set by the British government. Government policy has fluctuated on the issues of European collaboration. For example, during 1975 the general attitude of the Department of Industry was that perhaps one stop-gap national civil project should be indulged in, and then subcontract work should be sought from the U.S.[16] However, after positive participation in the EEC referendum, the climate changed once more and collaboration was seriously considered. European cooperation on present projects is discussed in a later section of this chapter.

The Role of Government in Other Industrial Sectors

In addition to the nationalized aerospace industry, Rolls Royce and British Aerospace, four other industries were partially or fully nationalized:[17] British Leyland (motor vehicles), the British Steel Corporation, shipbuilding and repair, and machine tools. This series of nationalizations was effected to prevent the collapse of a large portion of British industry. The other sectors of the economy which have been totally or partially nationalized are transportation (rail and air transport), the utilities, oil and coal production, and communications (post office and telecommunications). These firms account for approximately ten percent of the output and seven percent of the employment of the British economy.

Apart from the British Steel Corporation, nationalized industries have relied almost entirely on loan capital for external financing, and only the railroad industry receives an operating subsidy. The government also provides exchequer dividend capital (the purchase of firms' stock by the government) to firms which are viewed as highly sensitive to business cycles. The industries currently benefitting from this type of assistance are the airlines, aerospace manufacturing, steel, and shipbuilding.[18]

The government policy for public enterprises was delineated in a 1967 White Paper (Cmnd. 3437). This document stated that these firms were to behave as if in the private sector with respect to financial performance goals and the undertaking of investment, except when instructed otherwise by the government (in such cases they would be compensated on a pro rata basis by the Exchequer).

FRANCE

France's aerospace industry, like those of other European countries, consisted in its early days of many small manufacturers that gradually merged over time. The first of a series of consolidations began in the late 1930s. The six companies formed as a result of consolidations were also nationalized--for reasons which included the promoting of commonality and the sharing of a capital pool as well as the necessity of having a critical mass for production.[19] In the late 1950s, further consolidation of these companies occurred with the creation of Sud Aviation and Nord Aviation. Continued need of large amounts of capital for the development of new aircraft prompted the final step, the formation of Aerospatiale (SNIAS) in 1970. Today there is only one other major airframe company in France, Dassault-Breguet, which until 1977 was entirely in private hands. Other than the UK's Rolls Royce, Europe's only other major civil engine manufacturer is also a French company, SNECMA, which is nationalized.

As early as 1974, the French government was facing a dilemma over its leading civil aircraft manufacturers. At that time Aerospatiale, which is joint contractor for both the supersonic Concorde and the A-300B Airbus, had announced its third red ink year in a row, reporting losses of $100 million.[20] The company was reeling from the combined impact of its major civil aircraft programs' taking a turn for the worse, i.e., cost overruns on the Concorde (which raised the original price of $15 million for each aircraft to $65 million) and the poor initial sales showing of the Airbus.[21] One possible step, that of trimming the firm's 41,000 employees, was postponed by the government which decided instead to provide a $100 million subsidy.[22] This was done despite a study conducted by Aerospatiale itself recommending the laying off of 6,000 employees immediately--an action not agreed to by the government because of the shaky French economy.[23]

The government's dilemma is that aside from the national esteem in which it is held by the French, the aerospace industry has a strategic economic role; it achieves a positive balance of trade, exporting about 50 percent of output, thus ranking among the country's most effective exporters. The government is therefore understandably concerned with maintaining the health of this industry which not only provides a pool of highly skilled labor but brings in considerable foreign currency as well.

As already illustrated in the case of Aerospatiale, the government is willing to provide financial support to the civil aerospace industry. Funding in aerospace is generally provided in the form of repayable loans. For example, loans are provided with relatively low interest rates so that manufacturing programs for quantity production airframes and engines can be launched.[24] In this way, state aid can be used to compensate for the difference between the cost of an aircraft (higher at the start of the production run) and the sales price calculated on the completion of a given production run.[25] Other forms of assistance include the financing of development costs for specific civil aircraft projects, notably the Concorde, as well as funding of miscellaneous research.[26] Other than the Concorde, the most significant civil projects which have enjoyed government assistance are the Airbus, Mercure 100, Falcon 50, the CFM-56 turbofan engine and a variety of helicopters.[27] In addition, the French government has intervened in the marketing area by offering preferential interest rates for exporters--i.e., the state pays the difference between a special interest rate for exporters and the ordinary market rate.[28]

Despite this considerable financial assistance, the French aerospace industry continues to be besieged by difficulties. In 1974, a Finance Ministry study was released recommending the splitting of the commercial aircraft business between Aerospatiale, suffering its Concorde problems, and Dassault, which for the most part builds military aircraft.[29] At that time, Dassault had just recovered from a disastrous entry into the commercial market with its short-range Mercure, although the outlook for future military contracts remained good. The proposed plan was based on the assumption that Aerospatiale would benefit by becoming a major subcontractor for Dassault. The plan was never put into effect primarily because there were few assurances that Dassault would not itself be damaged by this arrangement.[30] The underlying problem, which continues to this day, is that the commercial aircraft division of Aerospatiale is so severely short of work that its losses exceed the profits of the space, missile and helicopter divisions.[31]

Government support of the aerospace industry has traditionally had public approval; the technical achievements of the 1950s have been and in some cases continue to be rewarded with commercial success (the massive state investments of the first two postwar decades paying off in money and prestige).[32]

However, the large investments of the past decade have not yet shown laudable commercial returns, a fact which contributed to the inquiry by a special committee of the National Assembly into public spending on French aerospace in 1976.[33]

The Dassault tax evasion and embezzlement scandals exposed in the same year were a further blow to the industry's public standing. Demands for nationalization were heard as a result, with the Socialist opposition vowing to nationalize Dassault, as well as a number of other large companies, if it came to power.[34] In June 1977, the government announced that it would convert its investment in Dassault into a 30 percent blocking minority to be used to control overall policy decisions without interfering in daily operations.[35] A government coordinating board was also established to oversee the activities of both Dassault and Aerospatiale. However, specific action was not taken until 1978 when the French Cabinet appointed four civil servants to the board of Dassault. This is as far as the government has managed to proceed, having had problems establishing its minority shareholding which apparently can only be resolved through legislation.[36]

The French aerospace industry today remains very dependent on the government for assistance and overall policy formulation. French policy has centered on civil aerospace products and markets--international collaboration, with France as a major partner, is seen as the key to survival. Aerospatiale's priority is without any doubt the continuation of the Airbus Industrie program (described in a later section in this chapter). The program is seen as the basis for European cooperation in the future. After an attempt to collaborate with McDonnell Douglas on the Mercure 200/ASMR, France has decided to emphasize European collaboration while not totally excluding some cooperation with the U.S.[37]

French officials have stated they no longer feel it is "possible or responsible to build aircraft just to feed design teams in factories."[38] At the same time, Aerospatiale's aircraft division has been reduced by only 2,400 personnel--due to attrition--although working time has been cut by about 10 percent by instituting unpaid holidays during the year.[39] Dassault, meanwhile, has had a slight decline in its work force to just under 15,000 in 1977. This company triumphantly staged the first flight of its Mirage 2000 prototype on the eve of the 1978 French National elections (in which the Left, with its

plans for outright nationalization of Dassault, was defeated). It also continues work on the Mirage Delta 4000--a privately financed venture of considerable proportions undertaken, despite the lack of a confirmed market, to keep a design office and valuable team of engineers in business.[40] Dassault is not presently involved nor does it have immediate prospects for involvement in joint European aircraft development and production.

The Role of Government in Other Industrial Sectors

In addition to most of the aerospace industry, certain other sectors of the French economy are nationalized. A few sectors (some oil companies, fertilizer producers, and the railroads) were nationalized before World War II, and the majority of the utilities were nationalized following the war.[41] The sectors nationalized as of 1978 include:

- Manufacturing--aerospace (not all), automotive (Renault only);
- Minerals--fertilizers, coal, gas;
- Utilities--electricity, gas distribution, post office (government department), telecommunications (government department);
- Transportation--Paris Metropolitan transport system, airlines, railroads:
- Other (some nationalized firms)--ocean shipping, chemical firms, banking and insurance.

These industries account for approximately ten percent of employment and output in the French economy. The major forms of government financing for these industries include direct subsidies (notably for the railroad industry), loans and loan guarantees, and public dividend capital.[42]

Traditionally, the French government's relationship with public sector enterprises has taken the form of a highly centralized system of control. By 1967, pressures had mounted for a review of public corporation policy-attributable to the constraints of highly centralized decisionmaking, heavy public-sector borrowing, deteriorating labor relations and management pressure. This review resulted in the Nora report, which represented France's first efforts at formulating specific objectives for public enterprise. Commercial, market-oriented objectives were to complement public service objectives, e.g., the contrat de programme was introduced as a format in which financial objectives were mutually agreed upon by the French government and the public corporation.[43]

THE FEDERAL REPUBLIC OF GERMANY

The West German aerospace industry has had three discernable development phases since it was rebuilt following World War II.[44] The initial phase, spanning a five-year period, involved setting up new production facilities and manufacturing equipment for the newly re-formed defense forces. The second phase was marked by the beginning of two license-manufacture programs, the Lockheed F-104G and the Fiat G-91, as well as a certain amount of original research and development work. The industry expanded quite rapidly during this period to find itself faced with two major difficulties in the mid-1960s--a lack of significant follow-on programs and a complex industry structure not suited to modern, large-scale aircraft programs. To improve this situation, industry and government entered into a concerted effort in the late 1960s with the eventual goal of restructuring the industry. This third development phase marked the beginning of large-scale production of civil aircraft, government aid for the projects in both development and production phases, emphasis on international cooperation, and intensified marketing efforts. The Finance Ministry conducted an extensive review of the industry at this time, producing a medium-term development program which outlined plans for the industry from 1970 to 1974 with particular emphasis on civil projects. Although adopted by Parliament with the condition that it be resubmitted annually and revised on a rolling basis, it was not to have the impact of later government studies.[45]

The industry today is still somewhat affected by the earlier development phases. The Federal Government's initial failure to provide overall direction (although large sums of money were spent on rebuilding Germany's aerospace capability) left the industry subject to the demands of the various Lander, or provinces, which today still help support the individual research and development centers within their local jurisdiction.* Despite consolidation efforts--until the formation of VFW in 1963 there were thirteen aerospace companies, today there are only three major firms--the geographic fragmentation of research and production facilities contintue to be a significant handicap to both production and marketing efforts.[46]

---

*The Lander's civil aeronautic research and development funding is about ten percent of the amount expended by the Federal Government.

A second effect of practices in the earlier decades is that the West German industry is still very dependent on national government contracts and has not been highly export-oriented. In contrast to the British and French industries, exports accounted for only 12 percent of turnover in 1972.[47] By 1975, 80 percent of the industry's turnover still derived from orders placed by the Federal Government.[48] In the past, the government funded projects primarily for domestic military purposes; until recently there has been no great incentive to find additional markets.

It was not until the mid-1970s, with the appointment of Martin Grüner as aerospace coordinator, that the government began to formulate a national aerospace policy, recognizing that: (1) the most urgent potential problem was the continuation of needed financing of the major civil programs, the A-300B and VFW 614, in an industry which since 1970 had become greatly indebted both to the German government and to private creditors; and (2) the danger in the long run of the industry's ending up with excessive development and production capacity both in the DFVLR (the national aerospace research facility) and in the technical schools.[49]

Grüner submitted an extensive report to the Federal Cabinet for approval at the end of 1975. Continued government support was recommended based on general guidelines including (1) the support of the industry's efforts towards the development of more efficient and economic company organizational structures and (2) the strengthening of the industry's international competitiveness--but not to compete with the U.S. over the entire aerospace spectrum.[50]

Grüner's plan included a step-by-step outline for future federal aerospace policy, making specific recommendations for major programs such as the Airbus, the VFW 614 and the Multi-Role Combat Aircraft (MRCA). It was stressed that government support would not necessarily offer guarantees of continued employment in the 1980s.[51] For this reason, Gruner emphasized that new international cooperative ventures should be sought to secure continued participation in civil aircraft projects. This also corresponded with the contemporary political climate--the West German Parliament was providing funding for the A-300B and VFW 614 only because doing so was specifically tied to the concept of further European cooperation, which would perhaps result in an eventual restructuring of Europe's industries on a common market basis.[52]

Germany's aerospace industry is considerably smaller than its counterparts in the United Kingdom and France. Until recently, none of its aerospace firms had suffered the crises occurring earlier in other countries; the companies have generally been profitable with total sales rising steadily through the mid-1970s even allowing for inflation.[53] There has been some fluctuation in the work force of the aircraft production industry, but as yet no major layoffs.[54] Messerschmitt-Bolkow-Blohm (MBB), because of its heavy involvement in military work, is seen as being relatively secure despite shrinking space activity and the risks encountered in civil aircraft production (it should be noted that the Airbus project, in which MBB is participating, depends on continuing government subsidy). The family-owned Dornier group appears to have avoided the high risk of civil projects, depending on military programs. The third airframe manufacturer, VFW-Fokker, the German division of an international "merger" with the Dutch Fokker, was severely threatened in 1977 by the cancellation of the VFW 614, requiring government rescue with a cash injection of $250 million.[55] This program lapsed (after the construction of only 16 aircraft) primarily because a firm market did not exist for the aircraft. In contrast to U.S. practice, the launching of civil aircraft programs occurs in Europe often before enough large orders are received to indicate market acceptance.

The industry was largely left on its own with respect to plans for continued consolidation efforts even though the government urgently felt restructuring was needed. Grüner, in his 1975 report, had even gone so far as to suggest a sphere of influence plan in which weapon systems development and satellite construction would be concentrated in the South with civil aircraft and manned spaceflight in the North. These suggestions were not put into effect and no further consolidation took place until the threatened collapse of VFW-Fokker.

The crisis caused by the VFW 614 cancellation reversed this earlier policy. The government became actively involved in laying the groundwork for a future merger of MBB and VFW-Fokker. This industry reogranization was instigated at the specific request of the government because of concern over the increasing economic risk it has incurred in supporting new programs undertaken by German industry. The government agreed to pay the costs incurred by the VFW-614 termination only after VFW-Fokker officials

agreed to begin merger discussions with MBB; however, no particular form of reorganization was proposed by the government as a condition of providing aid.[56]

The recent government action, which has in effect ushered in a fourth industry development phase, was also motivated by the following considerations: (1) VFW-Fokker's particular difficulties could best be resolved by its merger with the stronger MBB; (2) the German industry, in general, would soon face a problem of overcapacity, though minor compared to other countries; (3) although generally satisfied with Airbus Industrie's performance, the government felt that it would have been better for Germany if MBB and VFW-Fokker could have spoken with one voice; and (4) in light of the consolidation occurring in Britain and France, German industry must also be sufficiently unified.[57]

Although Britain's nationalization moves were viewed with approval (because they trimmed organizational overheads and attempted to match capacity to workload), Germany has no intention of nationalizing its aerospace industry.[58] The Ministry of Economics does not see itself as having the experience or need to be directly involved in industry; furthermore, nationalization is seen as an obstacle to further international cooperation.[59]

Civil aircraft production continues to be based on specific programs with government assistance in the area of development, launching aid and marketing. The German government also funds more general research work under several different contracts with the intent of developing new technology for application in the military aircraft field and aviation in general.[60]

The Role of the Government in Other Industrial Sectors

In contrast to Great Britain and France, the German aerospace industry remains in the private sector although it receives considerable government financial support. However, other industrial sectors are nationalized and account for over ten percent of national output and about eight percent of national employment.[61] The primary sectors which contain nationalized firms include the following:[62]

- transport--airlines and railroads;
- utilities--electricity, gas and postal service; and
- manufacturing--steel, aluminum, chemicals, and shipbuilding.

Furthermore, the various states (Lander) and municipalities are shareholders in many firms. The most notable example of this is Volkswagen, of which the federal and state governments own 36 percent. Most of the nationalized industries are self-sufficient in financing, requiring only occasional government assistance. A significant exception is the railroads which have received subsidies on the order of $1 billion annually in recent years.[63]

Decentralization has been the prevalent government policy with respect to nationalized industries. There is not much evidence indicating that Germany will adopt the policy of centralized control as in Great Britain and France. In fact, about fifteen years ago the government de-nationalized some firms--implemented through selling small shares of stock to the public. Recently, a call has been made to continue the process along a more rational organization of the government's industrial holdings to improve economic performance.[64]

THE NETHERLANDS

Fokker-VFW is the one major airframe company in the Netherlands aerospace industry, with the Philips group involved in engine and avionics production.[65] It is the Dutch division of a new company (wholly owned by two former companies, Fokker of the Netherlands and VFW of West Germany) which was set up in 1969. The "merger" of the two firms, each taking a 50 percent share in the holding company, was undertaken to permit consolidation without sacrificing legal independence. The financial status of the company has fluctuated considerably in the past decade, with the work force remaining within the 6,500-7,000 range.[66]

Sales of the F-27 and the popular F-28 fell off in 1976 but the F-16 program, to be begun after considerable delay, was expected to compensate by providing more work. By September 1978, Fokker-VFW was also reaching a critical decision point--whether to maintain its short-haul transport market share by introducing the Super F-28. The company was seeking partners in other European countries based on the type of cooperation established for the F-28 program. The government had provided funds to assist the earlier project. The launching of the Super F-28 would be contingent upon the Dutch government's funding a part of the $400 million needed to develop the aircraft for delivery by 1983-84.[67] Financing plans for the Super F-28 called for an outright

government loan of $125 million and the guarantee of an additional bank loan of $155 million to be paid back on each aircraft sold until the break even point, after which the government would receive a royalty based on a percentage of sales.[68]

The British Aerospace HS-146, a program recently brought back to life, has characteristics similar to both the successful F-28 and the proposed Super F-28. Fokker officials have claimed that the HS-146 is being built to ensure employment rather than to meet the needs of the market as does the Super F-28.[69] In October of 1978, the ECC was considering a formal Dutch Government protest over the British plans which, it was claimed, ran counter to a 1975 ECC resolution that member countries would not produce aircraft with the same characteristics.[70]

Fokker-VFW currently faces difficulties in West Germany as well. As has been discussed, the proposed merger of MBB and VFW-Fokker is likely to preclude the continuation of the international relationship maintained between Germany and the Netherlands for almost a decade. German officials have stated that they hope a more appropriate arrangement can be developed to continue joint efforts.[71]

The Role of the Government in Other Industrial Sectors

The transport, telephone, telegraph and postal systems of the Netherlands are all state owned monopolies. In addition, the government holds all the shares of a corporation engaged in the businesses of chemical products, plastics, industrial chemicals, energy, plastic processing and building. This corporation is fully autonomous, however, not monopolistic, devoid of political influence, and is tied to the government only through the Minister of Economic Affairs. The government also holds 50 percent of the shares of the sole Dutch company engaged in the purchase, transmission, distribution and export of natural gas (primarily Dutch origin natural gas) although, here again, the company is fully autonomous and not an instrument of national policy.

EUROPEAN COLLABORATION

In recent years, the general consensus among European governments and aerospace industries has been that collaboration remains the one route to survival, given the large initial capital requirements for and the long period

required to obtain a return on major civil aircraft and engine programs. As is clear from the preceding discussions, European governments still have national aerospace policies and EEC sponsorship of a European aircraft industry is not yet a reality. Therefore, there is still a need for intergovernmental and interindustry cooperation. With few exceptions, the major civil airframe and engine manufacturers discussed in the previous sections have each engaged in at least one effort at international collaboration--usually with government financial support. The following summary discussion describes two major civil aircraft projects, the supersonic Concorde and the A-300B Airbus program, which are examples of European collaboration which achieved definite technical--if not yet commercial--success.

Aerospatiale/BAC Concorde

The origins of the supersonic Concorde can be traced back to 1961, when Sud Aviation (France) and the British Aircraft Corporation began to exchange views on their respective preliminary studies of supersonic flight.[72] This led to a proposal for collaboration which the two governments agreed to support, and an agreement between the countries was signed on November 29, 1962. Specific characteristics of the aircraft were agreed on at this point, with the Bristol Olympus chosen as the engine, to be developed by Rolls Royce in conjunction with SNECMA.

From its beginning, the project suffered delays due primarily to the committee management system which had been set up, under which even minor decisions were subject to conflicting nationalistic interests. Technical and financial problems also plagued Rolls Royce during engine development. The project ended up taking much longer than expected; fourteen years elapsed before a product was brought into service.

The most serious effect of this delay was the dramatic escalation in the costs of the project and subsequently the cost of the aircraft. Today, only sixteen Concordes have been produced with five still available for sale or lease; Air France and British Airways, the state airlines of the two producing nations, have been the only customers. Both airlines benefited from government financial support to purchase this aircraft and still receive operating subsidies.

In addition to the problems with the aircraft attributable to costs, the Concorde has met with opposition on environmental grounds (which was a major factor in the cancellation by Congress of the U.S. SST), particularly take-off and landing noise, supersonic boom and disturbance of the atmosphere. The problem of noise results from an engine designed in the 1960s which does not meet new FAR 36 regulations--thus this problem, too, is a result of the long delay before production.

Production of the Concorde was halted in early 1978. Although the United Kingdom and France are proud of their achievement--which has, indeed, been a technical success--plans for a moderately improved "Concorde B" are not likely to be undertaken.[73]

Airbus Industrie A-300

This program, a collaborative effort between French, British, and German aerospace industries, was under consideration as early as 1964 when the possibilities of developing a high-capacity aircraft with a short or medium range were first examined.[74] The effort was almost abandoned; however, a complete review of the specifications on the basis of a wide-body configuration to be powered by a new generation engine (the CF6-50, developed and produced by a U.S. firm, General Electric) proved encouraging enough for a formal agreement to be signed on May 28, 1968, by the French and German governments, joined later by the governments of the Netherlands and Spain. The British government withdrew from the program (and is today, a decade later, negotiating to participate as a risk-sharing partner) although it maintained a major stake through the work of Hawker Siddeley. The other firms involved were Sud Aviation (later merged into Aerospatiale), MBB, and VFW-Fokker--and Fokker-VFW and CASA eventually became associated with the project.

The management system was set up as a special corporation, Airbus Industrie, inaugurated in December 1969. This organization proved relatively effective--it took under five years for the first B-2 to be certified. In May 1975, the longer-range B-4 was brought into operation.

The project, though a technical success and one of the best examples of effective European collaboration, has suffered poor sales. By April 1977, orders totalling only 39 units had been placed by European and other non-U.S. airlines.[75] Recent sales have improved the outlook for the A-300, however, particularly with the purchase of 23 aircraft (with options on 34 more) by

Eastern Airlines[76]--a sale which evoked considerable controversy in the United States regarding the financial incentives provided by the European governments to close the sale.

Plans for further development of the Airbus family, particularly the A-310 and the proposed joint European transport program (JET), have been made for the near future, and it appears that Airbus Industrie will provide a continuing structure for European collaboration.

SUMMARY

The four European countries examined in this study have provided considerable financial support for the aerospace industry. The role of the industry as a provider of employment, technology and export earnings and the large commercial risks involved in civil aircraft and engine programs have been the primary reasons cited for this support. Each government, however, has been a major force in movements to rationalize the structure of its aerospace industry in order to operate more efficiently and to better meet foreign competition. During the past twenty-five years, a few major companies have evolved in each country through the consolidation of smaller firms.

Britain and France have employed nationalization as a mechanism to achieve rationalization, reflecting their policies of government control of concentrated industries in what are viewed as important sectors of the economy. On the other hand, while Germany has taken steps to rationalize the aerospace industry, it has elected to keep the firms in the private sector while providing financial support. The Netherlands' one major company, Fokker-VFW, has remained in the private sector, although its major programs do receive government assistance.

NOTES

[1]Bernard Aubreton, "A New British Giant in the Aerospace Field," ITA Bulletin, 22 (June 13, 1977), 499-501.

[2]"United Kingdom Aerospace: The Industry Awaits a Firm Government Policy," Interavia (September 1974), 829-830.

[3]"Nationalisation-the Policy Document," Flight International (January 23, 1975), 83.

[4]"Britain Seeks to Naturalize BAC, Hawker Siddeley by 1976," Aviation Week & Space Technology (January 20, 1975), 26.

[5]"Nationalisation-the Policy Document," 83.

[6]Ibid., p. 83.

[7]Ibid., p. 84.

[8]Ibid., p. 84.

[9]Derek Wood, "The British Aerospace Industry: Awaiting Government Decisions," Interavia (September 1975), 952.

[10]Ibid., p. 953

[11]Ibid., p. 953.

[12]"United Kingdom Aerospace: The Industry Awaits a Firm Goverment Policy," 829.

[13]"A New British Giant in the Aerospace Field," 499.

[14]Wood, Op. Cit., p. 953.

[15]Ibid., p. 953.

[16]Ibid., p. 953.

[17]Donald Roy, "The Role of Public Enterprise in the British Economic Crisis of the 1970's," Annals of Public and Co-operative Economy, 48 (October-December 1977) p. 429-30.

[18]Ibid., p. 432.

[19]Forecasting International, Ltd., A Study of the Key Aspects of Foreign Civil Aviation Competition, Hampton, VA: Forecasting Int'l, (October 1976) 75.

NOTES, (Cont'd)

[20]"France: Emergency Refueling for Aerospatiale," Business Week (November 2, 1974), 34-37.

[21]Ibid., p.34

[22]Ibid., p. 34

[23]Ibid., p. 34

[24]"Financing of Major French Civil Aircraft Programmes," ITA Bulletin (June 23, 1975), 552.

[25]Ibid., p. 552

[26]"French Government Aerospace Spending: Right or Wrong?," Flight International (May 14, 1977), 1363.

[27]Ibid., p. 1363.

[28]"Financing of Major French Civil Aircraft Programmes," 553.

[29]"France: Emergency Refueling for Aerospatiale," 34.

[30]Ibid., p. 37.

[31]"France's Aerospace Industry," Flight International (November 19, 1977), 1507.

[32]"France's Aircraft Industry," Flight International (November 27, 1976), 1577-1578.

[33]Ibid., 1577.

[34]"French Government Aerospace Spending: Right or Wrong?" pp. 1508 1905.

[35]"France's Aerospace Industry," 1509.

[36]"Dassault 2000 Goes Supersonic on First Flight," Flight International (March 18, 1978), 742.

[37]"France's Aerospace Industry," 1508.

[38]"France's Aircraft Industry," 1577.

[39]"France's Aerospace Industry," 1508.

NOTES, (Cont'd)

[40]"Priorites Francaises," Flight International (April 29, 1978) 1303.

[41]G. Corti, "Perspectives on Public Corporations and Public Enterprises in Five Nations," Annals of Public and Co-operative Economy, 47 (January-March 1976), p. 54.

[42]Ibid., p. 49.

[43]Ibid., p. 57.

[44]"West Germany's Aerospace Industry--Disillusioned with Europe," Interavia (May 1974), 428.

[45]Ibid., p. 429.

[46]"The West German Aerospace Industry: State Control or Free Enterprise?," Interavia (May 1975), 315.

[47]"The West German Aerospace Industry, an Agonizing Reappraisal in Bonn," Interavia (July 1975), 773.

[48]Ibid., p. 773.

[49]"The West German Aerospace Industry, an Agonizing Reappraisal in Bonn," 774.

[50]"The West German Aerospace Industry: State Control or Free Enterprise?," 315.

[51]Ibid., pp. 315-316.

[52]"West Germany's Aerospace Industry--Disillusioned with Europe," 429.

[53]Ibid., p. 772.

[54]Ibid., p. 772.

[55]"The West German Aerospace Industry: State Control or Free Enterprise?," 318.

[56]"Germans Begin Reorganizing Aerospace," Aviation Week & Space Technology (March 13, 1978), 209.

[57]Ibid., p. 209.

NOTES, (Cont'd)

[58]"West Germany's Aerospace Industry," Flight International (May 1, 1976), 1145.

[59]"Germany's Aerospace Industry," Flight International (April 29, 1978), 1277.

[60]"Germany Industry Stability Expected," Aviation Week & Space Technology (April 24, 1978), 73.

[61]G. Corti, "Perspectives on Public Corporations and Public Enterprises in Five Nations", p. 49.

[62]Ibid., pp. 64-71.

[63]Ibid. p. 64.

[64]Ibid. p. 67.

[65]"European Aerospace Industry: Competitiveness and Market Shares," Interavia (June 1977), 590.

[66]Ibid., 591.

[67]"Fokker Nears Decision on Super F-28," Aviation Week & Space Technology (September 4, 1978), 159.

[68]Ibid., p. 163.

[69]Ibid., p. 159.

[70]"World Roundup: The Netherlands," Business Week (October 2, 1978), 48.

[71]"Germans Begin Reorganizing Aerospace," 209.

[72]Unless otherwise noted, this discussion is based on a speech by Henry Ziegler, "Multinational Cooperation in Aerospace Projects: Cooperation Between Europe and the United States," published in ITA Bulletin, (November 2^, 1975), 963-970.

[73]"Europe's Major Civil Aircraft Programmes," Interavia (June 1977), 592.

[74]Speech by Henry Ziegler, Op. Cit. 963-970.

[75]Europe's Major Civil Aircraft Programmes," 592.

[76]"Eastern Lenders Give Approval for A300 Buy," Aviation Daily (June 1, 1978), 178.

III. GOVERNMENT FINANCIAL SUPPORT

BACKGROUND

This chapter presents information about recent expenditures for civil aircraft and engine research, technology, and development in the United Kingdom, France, West Germany and the Netherlands. As the data presented below indicate, the majority of this funding in the 1974-77 period has been for the development of specific projects. A smaller amount is spent by each country to develop its research and technology base. It should be noted that, wherever possible, all data were obtained from official documents; in a few cases it was necessary to supplement this information through interviews with government officials. In keeping with NASA-established guidelines for this study, only those expenditures for civil airframe and engine research, technology, and development are presented. Where no sound basis was available to allocate the civil portion of joint civil-military expenditures, the total is reported here as a joint expenditure. The information on which these figures are based was developed jointly by GRA and INSPEC, and represents the study team's best estimate of European governmental expenditures in this area. All financial data in this chapter have been converted to U.S. dollars (current) to facilitate comparisons by the reader. The exact conversion factors used are shown in Appendix B, Table A-1.

UNITED KINGDOM

The British government provides financial assistance for both project development and research and technology activities. These funds are disbursed through the budgets of two agencies--the Ministry of Defense and the Department of Industry.[1] Civil research and technology activities in particular are administered by contract through the Ministry of Defense, Procurement Executive (MOD(PE)). Development expenditures for some specific projects (e.g., the RB-211 engine) are also controlled in a similar fashion. However, net government expenditures by MOD(PE) for purely civil programs are reimbused through a budget transfer from the Department of Industry which also provides MOD with funds for contract administration.[2]

The government provides assistance to the industry in the form of direct aid to corporations as well as contributions to special projects. "Direct aid" includes long-term loans, purchases of capital stock and contributions to working capital. Expenses in connection with certain projects, such as the Concorde aircraft, are also underwritten by the government. These activities are funded directly by the Department of Industry.

The British government does seek a return on the capital it provides to the aircraft industry. Investment in aircraft companies (through loans or stock ownership) entitles the government to participate in corporate revenues, while the extension of assistance to individual projects is often contingent upon the government's eventual reimbursement from project sales. Such receipts have been treated as supplements to the government's appropriations for aerospace projects and programs, and are identified in the budget as "appropriations in aid." Thus, the government offsets the yearly grant of program funds with any amounts due it as a return on prior investments. Evaluation of the government's role in fostering aerospace activities, therefore, requires examination of both the net contributions of the government (i.e., less receipts) and gross expenditures (including receipts) available for government-sponsored work.

The two primary sources of data for the United Kingdom were annual reports of Supply Estimates and Appropriation Accounts by the House of Commons

for fiscal years 1973-1974 to 1977-1978.* The former document presents the initial funds budgeted for each fiscal year. The Appropriation Accounts present the final amounts appropriated for each activity, reflecting all supplemental appropriations during the fiscal year. The Appropriation Accounts also report net expenditures and provide explanations for the differences between amounts appropriated and expended. The Supply Estimates document is useful as information is presented at a much greater level of detail.

Total net expenditures for civil aviation for fiscal years 1974-1977 appear in Table 3-1. Both initial and supplementary appropriations are presented in the amounts shown for each year. Total expenditures declined from £177.1 million ($417.3 million) in 1974 to £83.5 million ($159.1 million) in 1977. Expenditures for general research and development (including research and technology) ranged from £14.4 million ($33.8 million) in 1974 to £17.9 million ($34.1 million) in 1977. Project-related expenditures appear in separate accounts in the budget. The decline in total expenditures during the period has its origin principally in the Concorde aircraft and RB-211 engine projects: Net expenditures for the Concorde declined from £87.7 million ($206 million) in 1974 to £47.8 million ($91.1 million) in 1977; and net expenditures for the RB-211 engine project declined from £37.7 million to £12.1 million ($88.6 million to $23 million) during the same period.

Table 3-2 shows actual government expenditures during the period 1974-1977 for civil aircraft and engine programs. These data correspond to expenditures as reported in Table 3-1, but show both gross expenditures and offsetting receipts. Since receipts are used to fund a portion of the current year's expenditures, actual government assistance corresponds more closely to gross expenditures. That is, receipts due the government from companies for prior investment are deducted from that year's appropriation; the government then transfers the net amount of the grant to the company.

The decline in civil aviation project expenditures corresponds to a period of uncertainty during which the government planned the nationalization

*1973-74=1974; 1974-75=1975; 1975-76=1976; 1976-1977=1977; and 1977-78=1978.

TABLE 3-1

GREAT BRITAIN: TOTAL ACTUAL GOVERNMENT EXPENDITURES FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT, 1974-1977[1]

(£ Millions, current)[2]

Net Expenditures	1973[3] 1974	1974-1975	1975-1976	1976-1977
Research & Development	14.4	16.2	16.6	17.9
Concorde Aircraft	87.7	81.4	79.8	47.8
RB-211 Engine	37.7	40.3	2.5	12.1
Other Civil Aircraft and Aero-Engine Projects, etc.	37.9[4]	26.4[5]	92.9[6]	5.7
TOTAL (£ Millions)	177.7	164.3	191.8	83.5
($ Millions)	417.3	332.5	333.2	159.1
Initial Annual Appropriations	150.1	110.2	59.2	49.8

[1]Total of expenditure appropriations during the year for civil aerospace research and development, the support of development and production of aircraft and associated equipment, loans, the purchase of certain assets of companies, and other items.

[2]Amounts shown are net government expenditures after receipts from repayment of loans and other repayments.

[3]Fiscal year begins April 1 and ends March 31.

[4]Includes net assistance to Rolls Royce of £35.3 million under the Rolls Royce (Purchase) Act of 1971.

[5]Includes net assistance to Rolls Royce of £20 million.

[6]Includes net assistance to Rolls Royce of £20 million.

Source: House of Commons, Appropriation Accounts Class IV, Vote 5-Industrial Innovation: Aerospace (various years), (London: Her Majesty's Stationery Office).

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE 3-2

GREAT BRITAIN: EXPENDITURES ON CIVIL AIRCRAFT AIRFRAMES AND ENGINES FOR RESEARCH, TECHNOLOGY, AND DEVELOPMENT, 1974-1977
(£ Millions, Current)

Gross Expenditures	1973[1] 1974	1974-1975	1975-1976	1976-1977
Aircraft and Aero-Engine General R&D Programs	14.4	16.2	16.6	17.9
Concorde Aircraft				
Current Expenditure-Development	38.5	40.9	42.2	27.0
Current Expenditure-Production	25.0	37.3	76.2	79.2
Capital Expenditure-Development	0.3	0.1	-	-
Capital Expenditure-Production	3.0	1.9	.5	0.1
Work by MOD(PE) Establishments	1.3	3.1	2.5	2.2
Production Loans	21.7	-	-	-
RB-211 Engine	37.7	40.3	2.5	12.1
Other Aircraft and Aero-Engine Projects and Assistance				
Other Civil Aircraft and Aero-Engine Projects	3.9	7.3	3.3	0.7
Ministry of Defense (PE)	1.5	1.4	1.8	2.0
Assistance to Short Bros. & Harland	-	-	0.7	5.9
Assistance to Rolls Royce	35.3	20.0	90.0	-
Totals	182.6	171.7	236.3	147.1
Receipts				
Concorde Aircraft				
Production Receipts	-	-	38.8	57.3
Capital Assistance Rentals	1.6	0.9	1.2	1.0
VAT Recoveries	0.5	0.9	1.5	1.6
Miscellaneous Receipts	-	0.1	-	0.7
Other Civil Aircraft and Aero-Engine Projects	2.8	2.3	2.9	2.9
Totals	4.9	4.2	44.4	63.5
TOTAL NET EXPENDITURES (£ Million)	177.7	164.3	191.9	83.6

[1]Fiscal year begins April 1 and ends March 31.

Source: House of Commons, Appropriation Accounts Class IV, Vote 5-Industrial Innovation: Aerospace (various years) (London: Her Majesty's Stationery Office)

and corporate restructuring of the British aviation industry. These planning activities were realized in 1977 with the creation of British Aerospace.

Initial annual budget estimates for the fiscal years 1974-1977 are shown in Table 3-3. As can be seen, the amounts actually expended have exceeded the budget estimates in every year. The principal difference between initial and total appropriations is assistance--loans, purchases of stock and capital assets, etc.--to Rolls Royce under the Rolls Royce Purchase Act of 1971. For purposes of comparison, the annual totals of initial appropriations are also included in Table 3-i (number in parentheses).

The Supply Estimates have been used to approximate the distribution of research and technology funds for each year. As shown in Table 3-4, the largest recipient of funds of this type has been industry. Additionally, some of the MOD(PE) funds are allocated to industry in the form of research contracts.

The majority of government funds (approximately 90 percent) are allocated to specific projects or are provided as assistance to certain firms in the industry (See Table 3-1). Although general research and technology has received a small share of total funding, the proportion of funds devoted to this activity has increased in each year. The Concorde SST program has received the largest amount of funds during the period. This is reflective of the production problems of the program which caused substantial cost increases as noted in Chapter 2. Rolls Royce was the second largest recipient of government funds in the 1974-1977 period. This assistance was authorized under the Rolls Royce Purchase Act (1971) which nationalized this firm. The nationalization of the country's major airframe manufacturers was effected in 1977.

With respect to future levels of support for research, technology, and development activities for civil airframe and engine programs, the British government has designed a plan for the next four fiscal years.[3] As a result of the formation of British Aerospace as a nationalized company in 1977, this firm will take over responsibility from the Department of Industry for research work on airframes directly relevant to its commercial activities.[4] Estimated expenditures for these activities are shown in Table 3-5. When compared to earlier levels of support (Table 3-1), a considerable reduction in expenditures

TABLE 3-3

GREAT BRITAIN: BUDGET ESTIMATES[1] OF GOVERNMENT EXPENDITURES, 1974-1977

(£ Millions, Current)[2]

	1973-[3] 1974	1974-1975	1975-1976	1976-1977	1977-1978
Research & Development	17.2	13.9	15.4	18.0	15.6
Concorde Aircraft[4]	91.4	75.4	50.9	35.4	43.1
RB-211 Engine[4]	37.8	15.2	-13.0	-2.3	-12.3
Other Civil Aircraft and Aero-Engine Projects, etc.	3.7	5.7	6.2	-1.3	-1.5
Total (£ Millions)	150.1	110.2	59.5	49.8	33.9
(£ Millions)	352.5	223.0	102.7	94.9	78.4

[1]Estimates of the amount required for the fiscal year for the expenditure of the Department of Industry on civil aerospace research and development, the support of development and production of aircraft and associated equipment loans, the purchase of certain assets of companies, and other items.

[2]Amounts shown are net government budgeted expenditures after receipts from repayment of loans and other repayments.

[3]Fiscal year begins April 1 and ends March 31.

[4]Includes expenditures for production and development.

Source: House of Commons, Supply Estimates Class IV, Vote 5-Industrial Innovation: Aerospace (various years), (London: Her Majesty's Stationery Office)

TABLE 3-4

GREAT BRITAIN: DETAILS--AIRCRAFT AND AERO-ENGINE GENERAL R&D PROGRAMS BUDGET ESTIMATES BY CATEGORY, 1974-1977

(in Percentages)

Gross Expenditures	1973-[1] 1974	1974-1975	1975-1976	1976-1977	1977-1978
Research and Development by Industry, etc.	53	58	58	54	49
Research by Universities	2	2	2	2	1
Work by the Ministry of Defense (Procurement Executive) for aviation research and development, including both expenses of R&D establishments and research by contract	45[2]	40	40	44	50
Total (percent)	100	100	100	100	100
Total Expenditures[3] ($ Millions)	33.8	32.7	28.8	34.1	-

[1]Fiscal year beings April 1 and ends March 31.

[2]Includes £1,348,000 for R&D work in connection with the Concorde aircraft. This amount is listed again for 1973-1974 in the details of Concorde expenditures.

[3]From Figure 3-1.

Source: House of Commons, Supply Estimates Class IV (various years) (London: Her Majesty's Stationery Office)

TABLE 3-5

GREAT BRITAIN: PROJECTIONS OF GOVERNMENT SUPPORT FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT

(£ Millions: 1977 Prices)

Projected Expenditures	1978-1979	1979-1980	1980-1981	1981-1982
Research and Development	15	15	15	15
Concorde Aircraft	33	24	17	13
R-211 Engine	(12)	(14)	(10)	(10)
Other aircraft and aero-engine projects, etc.	(1)	-	-	-
Totals (£ Millions)	35	25	22	18
($ Millions)	67	48	42	34

Source: The Government's Expenditure Plans, 1978-1979 to 1981-1982, Volume II, presented to Parliament by the Chancellor of the Exchequer by Command of Her Majesty (London: Her Majesty's Stationery Office, January 1978).

is shown. The reasons cited for this are the completion of the Concorde program in 1978 (with only the in-service support class remaining), and increased receipts from sales of the RB-211-22 engine which are expected to more than offset the development costs of derivative versions.[5] However, the design and development costs of the recently authorized BAe 146 are not included in the estimates in Table 3-5.[6]

It is expected that the British will continue to support major civil aircraft and engine programs in the future as in the past. However, much of this support will be directed through British Aerospace. The only reported estimates for government funding of British Aerospace indicate that capital expenditures of about $27 million are planned in each of the fiscal years through 1981. The government realizes that a requirement exists for external funding (public dividend capital and government loans), although British aerospace does expect to fund a large portion of the requirements from internal sources.[8]

FRANCE

The French Government supports all aspects of civil airframe and engine research, technology, and development. It supports both studies and product development for general aviation aircraft and engines, helicopter airframes and engines, business and commercial aircraft and engines, and transport aircraft, airframes, and engines. It has been a participant in most recent major European aircraft and engine programs (i.e., A-300--including proposed derivatives, the Concorde--including engines, the CFM-6 and CFM-56 engine programs, and diverse helicopter programs; the French Government is also attempting to organize a consortia to develop new transport aircraft--the JET Series).

The Ministry of Transport[9] provides most of the funding for research, technology, and development for civil aircraft and engines. It provides funds to industry, universities and research facilities. The major basic research organization is the Office National d'Etudes et de Recherches Aerospatiale (ONERA) which performs studies with both civil and military applications. Although data are presented below for ONERA, its expenditures are not included in the total figures to avoid double counting, as it receives some funds directly from the Ministry of Transport and other funds indirectly (that is, the Ministry of Transport's funds allocated to industry may be used for contract research at ONERA).

The government's total expenditures for civil aeronautic programs for the 1974-1977 period have ranged from approximately FF 1,100 million ($240 million) to FF 1,300 million ($290 million), as shown in Table 3-6. It can be seen that project development expenditures accounted for approximately 90 percent of total expenditures throughout the period.

Table 3-7 presents annual data on ordinary expenditures for the development of aeronautic equipment (including R&T). It should be noted that this figure, approximately $12 million in recent years, includes overall administration as well as development and research for avionics and other equipment.

The largest category of government-funded aeronautical work has been project development and financing (See Table 3-8). Approximately FF 950 to FF 1,200 million ($210 to $270 million) have been expended in this area annually from 1974 to 1977. The largest shares have been for the Concorde program and the 10-ton engine program (CFM-56). A note to this figure shows how the total funds for development were spent each year. The largest two recipient categories were publicly-owned companies and the funding of studies.

An accurate measure of the French Government's expenditures for research and technology on civil aircraft and airframes is not possible because of the method by which funds are supplied. Table 3-9 presents data for what can be classified as civil aeronautic research and technology. This activity has received approximately FF 72 million ($15 million) in each of the last three years for studies by research laboratories, universities, and industry. The relative size of this expenditure when compared to that of the other European countries indicates that it is not a true measure of French activity in this area.

ONERA conducts studies with both civil and military applications. As a basic research facility, some of its effort is pure science and the ultimate application is unknown. Since the ministry of Transport budget shows some funding for studies at ONERA, and this organization also may receive research contracts for industry programs funded by the Ministry of Transport, to include all these expenditures would entail a double counting of the government's contribution. Thus, the data reported in Tables 3-10 and 3-11 should not be added to those in Table 3-9.

TABLE 3-6

FRANCE: GOVERNMENT EXPENDITURES FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT 1974-1977

(FF Millions, Current)

Summary Data

	1974	1975	1976	1977
Ordinary Expenditures	44.2	52.8	60.6	62.8
Research and Technology Expenditures	47.3	65.8	78.8	72.0
Development Expenditures	1220.0	967.0	1030.0	1048.0
Total (FF Million)	1311.5	1085.6	1169.4	1182.8
($ Million)	295.1	242.0	235.3	251.4

Sources: Tables 3-7, 3-8, and 3-9.

TABLE 3-7

FRANCE: GOVERNMENT EXPENDITURES FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT, 1974-1977

(FF 000, current)

Ordinary Expenditures	1974	1975	1976	1977
Administrative Costs:				
Salaries	13,835	17,132	19,490	18,651
Allowances	8,902	10,282	12,343	13,781
Residence Allowances	841	924	1,034	965
Social Contribution	1,631	1,781	2,178	5,955
Payment of Compensation	741	830	982	1,085
Expense of Moving People	323	353	553	584
Material Costs:				
Technical Material	49	49	50	-
Fuel	4,613	7,213	6,300	7,200
Maintenance: Equipment and Material	9,755	10,605	12,853	9,418
Vehicles: Purchase, Maintenance and Operation	521	667	558	547
Other	2,380	2,380	3,511	3,548
Payments to Other Agencies (Printing & Communication)	584	584	724	1,078
Total Expenditures for Operations (FF 000)	44,175	52,800	60,579	62,812
($ 000)	9,938	11,770	12,189	13,350

Source: Budget Vote: Transports, III Aviation Civile, (Paris; Imprimerie Nationale), Chapitres 31-71, 31-72, 31-92, 33-90, 33-91, 34-71, 34-72, 34-92, and 34-93.

TABLE 3-8

FRANCE: GOVERNMENT EXPENDITURES FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT, 1974-1977

(FF 000, current)

Capital Expenditures: Development[1]		1974	1975	1976	1977
Concorde		800,000	510,000	535,000[2]	540,000[3]
Airbus		263,000	184,000	1,000	35,000
Mercure		65,000	17,000	-	-
Diverse Investments		17,000	20,000	18,000	8,000
10-Ton Engine (CFM-56)		64,000	205,000	436,000	370,000
SA 365 Helicopter		11,000	18,000	19,000	9,000
AS 350 Helicopter		-	13,000	6,000	9,000
Super Puma		-	-	15,000[4]	52,000[5]
Mystere 50		-	-	-	25,000
Total	(FF 000)	1,220,000	967,000[6]	1,030,000	1,048,000
	($ 000)	274,466	215,560	207,243	222,742

[1]Recipients of Funds by Type of Activity (in percents)

Type:	1974	1975	1976	1977
Construction of Facilities	2	2	2	1
Publicly-Owned Companies	87	74	56	61
Privately-Owned Companies	5	2	*	2
Expenditures on Studies--Economic, Technical, and Marketing	6	22	42	36

*Less than 0.5 percent

[2]FF 285 million for development and FF 250 million sales subsidy.

[3]FF 260 million development and FF 280 million sales subsidy.

[4]Includes FF 4 million for engine development.

[5]Includes FF 17 million for engine development.

[6]An additional FF 700 million was appropriated for Concorde sales subsidies. It could not be precisely determined whether any or all of these funds were ever expended.

TABLE 3-8 (cont.)

FRANCE: GOVERNMENT EXPENDITURES FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT, 1974-1977

(FF 000, current)

Source: Budget Vote: Transports, III Aviation Civile, (Paris: Imprimerie Nationale), Chapitre 53-24 for years 1974, 1975, 1976, and 1977. Assemblee Nationale, Rapport No. 2815, Vols. I & II, (Paris: Journale Officiale), April 1977.

TABLE 3-9

FRANCE: GOVERNMENT EXPENDITURES FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT, 1974-1977

(FF 000, current)

Capital Expenditures: Research and Technology	1974	1975	1976	1977
Light Aircraft Studies	3,500	3,500	3,450	3,000
Small Engine Studies	3,500	3,500	2,000	2,000
Preliminary Studies: New Programs	800	1,300	1,300	1,000
Preliminary Studies: Advanced Aircraft	-	10,000	-	-
Exploratory Development	-	-	-	12,000
Research and Test Sites: ONERA	7,000	7,000	5,000	8,000
General Research: Noise Pollution, Structures, Helicopters, and Security	33,000	40,500	67,000	46,000
Total (FF 000)	47,300	65,000	78,750	72,000
($ 000)	10,641	14,668	15,845	15,303

Sources: Budget Voté: Transports, III Aviation Civile, (Paris: Imprimerie Nationale), Chapitres 53-21 and 53-24, for years 1974, 1975, 1976, and 1977. Assemblee Nationale, Rapport No. 2815, Vols. I & II, (Paris: Journale Officiale) April 1977.

As Table 3-10 indicates, ONERA spends approximately FF 150 to FF 225 million ($30 to $50 million) per year for joint civil-military R&T. ONERA's capital expenditures are shown in Figure 3-11. Of the approximately FF 61 million ($13 million) spent per year, a little more than one-half has been for the transonic wind tunnel and related facilities at Le Fauga.

In summary, the French Government has stated that civil programs could not be launched without public funding. Aeronautical activity contributes greatly to the country's balance of trade and is a major source of manufacturing employment. Furthermore, it is also recognized that some stimulus of civil programs is needed to "escape the monopoly of several foreign builders."[10]

THE FEDERAL REPUBLIC OF GERMANY

In the Federal Republic of Germany, aeronautical research is conducted by the universities, independent research institutes, and the aerospace industry. Federal funds for these activities are provided by the Federal Ministries for Research and Technology (BMFT), of Defense (FMVg), and of Transport (BMV). It has been estimated that in 1974 as much as 75 percent of the funds expended on research and technology were provided by the Government (two-thirds of this amount were defense outlays).[11] Since 1973, individual projects have been subsidized as well, primarily in the aircraft industry (the research undertaken to assure technological preparation for future civil aircraft projects).[12]

The West German aerospace industry is composed of three airframe companies, supported by two engine manufacturers and a small equipment industry. The aerospace industry has traditionally been dependent on government support, primarily in development. Government aid has largely been tied to the condition that civil aircraft projects lead to increased European cooperation.[13] The Federal German Government Programme (published December 13, 1974) estimated that government aerospace funding of the industry for the years 1974 through 1977 would be allocated as shown in Table 3-12. It should also be noted that at least 80 percent of the German industry's turnover comes from business placed with the Federal Government; the industry has not been highly export-oriented.[14]

TABLE 3-10

FRANCE: GOVERNMENT EXPENDITURES FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT, 1975-1977

Joint Civil-Military Expenditures by
Office National D'Etudes et de Recherches
Aerospatiales (ONERA)

(FF 000, current)

Operations Expenditures	1975	1976	1977
Origin of Funding:			
Direct Allocation from Government	56%	51%	51%
Resources from Contracts (indirect government funding)	42%	47%	46%
Direct Returns (primarily royalties from patents)	2%	2%	3%
	100%	100%	100%
Uses of Funds for Airframe and Engine Research and Technology:			
Aeronautics (airplanes, helicopters, engines, and equipment)	111,500	136,000	160,800
General Studies	50,800	59,000	63,300
Total (FF 000)	162,300	195,000	224,100
($ 000)	34,495	39,235	47,630

Sources: ONERA, Activities 1975, Chatillon, France: ONERA, 1975.
ONERA, Activities 1976, Chatillon, France: ONERA, 1976.
ONERA, Activities 1977, Chatillon, France: ONERA, 1977.

TABLE 3-11

FRANCE: GOVERNMENT EXPENDITURES FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT, 1975-1977

Investment in Joint Civil-Military Research Facilities

(FF Millions, Current)

Use of Investment Funds[1]	1975	1976	1977
Test Centers:			
Chalais-Meudon (aerodynamics)	2.8	1.7	3.4
Palaiseau (energetics)	7.0	3.6	2.8
Modone (large wind tunnel)	7.6	11.6	9.3
Le Fauga (new establishments and F1 wind tunnel)	31.6	37.6	33.6
Laboratories of Châtillon (materials, physics structures)	6.0	7.8	8.9
Laboratories of the Toulouse Research Center	3.6	2.4	1.0
General purpose facilities	1.0	11.3	1.9
Total (FF Millions)	59.6	66.0	60.9
($ Millions)	13.3	13.3	12.9

[1]1974 data not available for inclusion in this report.

Sources: ONERA, Activities 1975, Chatillon, France: ONERA, 1975.
ONERA, Activities 1976, Chatillon, France: ONERA, 1976.
ONERA, Activities 1977, Chatillon, France: ONERA, 1977.

TABLE 3-12

WEST GERMANY: PROJECTED GOVERNMENT FUNDING FOR ALL AEROSPACE PROGRAMS, 1974-1977

(DM Million, current)

	1974	1975	1976	1977
Government Aerospace Funding				
Civil Programs[1]	244.0	274.0	327.0	350.0
Military Programs	2589.0	2795.0	2596.0	2464.0
Space Programs[2]	311.9	288.7	312.3	332.7
Civil Research[3]	7.4	10.0	13.2	17.0
Total (DM Millions)	3152.3	3367.7	3248.5	3163.7
($ Millions)	1308.0	1284.4	1375.3	1502.09

[1]Includes assistance in marketing.

[2]Funding for West German industry, plus contributions for administration at ERNO and the European Space Agency (ESA).

[3]Only funding for manufacturers; does not include research institutes.

Source: "The West German Aerospace Industry: An Agonizing Reappraisal in Bonn," Interavia (July 1975), 773.

The Federal Ministry for Research and Technology (BMFT) promotes general and civil aeronautical research and technology. BMFT appropriations, projected for the years 1974 through 1977, are displayed in Table 3-13. Actual expenditures for the same years are shown in Table 3-14. The major share of BMFT aeronautical funding supports research conducted by the Deutsche Forschungs- und Versuchsanstalt für Luft-und Raumfahrt (DFVLR). The DFVLR is the largest research establishment dealing with engineering sciences in the Federal Republic of Germany. Its "basic funding" appropriations have increased somewhat more than originally projected. In addition, the DFVLR enjoys support from the governments of the provinces in which its research centers are located. As shown in Tables 3-13 and 3-14, BMFT funds are also set aside for the Civil Component Program (limited largely to the airframe field) and other R&T projects within industry. Yearly expenditures for facilities also increased considerably more than first estimated.

Funding for the development of specific civil aircraft projects is not included in the Federal Government's overall program for aeronautical research and technology. A separate "medium-term development program," placing particular emphasis on civil ventures, was first submitted to Parliament in July 1970; the proposals were adopted with the condition that they be resubmitted annually and revised on a rolling basis.[15] A new program, for the period 1974 to 1978, was the subject of a report prepared by Martin Grüner and submitted to the Federal Cabinet at the end of 1975. An overall summary of project support is displayed in Table 3-15. National projects were recommended in the Grüner report only if they were well within the industry's capacity and would require only a minimum of government support. However, as can be seen in Table 3-16, the government has encouraged the larger multinational programs--the A-300 Airbus and the VFW 614--by advancing, in addition to development funding, support for export finance aid and marketing assistance.

The future support recommended for the continuation of the Airbus program is based on its eventual development into a family of transport aircraft. The Grüner report found that the costs of termination (with repercussions on international relations, employment and industry structure) would be greater than continuation for the period 1976 to 1980--DM 1,300 million ($549.9 million) for termination as compared to DM 1,150 million ($486.5 million) for continuation.[16]

TABLE 3-13

WEST GERMANY: PROJECTED BMFT APPROPRIATIONS[1] FOR CIVIL RESEARCH, TECHNOLOGY, AND DEVELOPMENT, 1974-1977

(DM Million, current)

	1974	1975	1976	1977
DFVLR[2] Basic Funding	35.0[3]	41.2	43.0	43.0
Civil Component Program	-	8.1	8.0	10.0
Facilities	-	4.0	5.2	6.0
Total (DM Millions)	35.0	53.3	56.2	59.0
($ Millions)	14.5	20.3	21.35	28.0

[1]The Federal Ministry for Research & Technology (BMFT) promotes general and civil aeronautical research and technology; only figures for aeronautical research funding are given here.

[2]The Deutsche Forschungs-und Versuchsanstalt für Luft-und Raumfahrt (DFVLR) is the largest aeronautical research establishment outside the universities. "Basic funding" represents those appropriations intended solely for aeronautical research.

[3]Actual appropriation for 1974; does not include DM 9.4 million set aside for individual projects.

Source: Ministry for Research and Technology of the Federal Republic of Germany, Aeronautical Research and Technology: Overall Program of the Federal Government 1975-1978. Translated from German by DFVLR, (Bonn, Germany: DFVLR), 1976.

TABLE 3-14

WEST GERMANY: GOVERNMENT EXPENDITURES FOR CIVIL AIRFRAME AND ENGINE RESEARCH, TECHNOLOGY, AND DEVELOPMENT,[1] 1974-1977

(DM Million, current)

	1974	1975	1976	1977
DFVLR				
Basic Funding[2]	40.0	42.0	44.5	48.0
R&T Projects[3]	7.4	7.4	9.3	10.0
Facilities		4.0	10.5	18.8
Total (DM Million)	47.4	53.4	64.3	76.8
($ Million)	19.7	20.4	27.2	36.48

[1]All figures, except those given for DFVLR, are taken from budget reports of the Federal Ministry for Research and Technology (BMFT) and represent actual expenditures, except for the 1977 data which are based upon appropriations.

[2]The figures are estimates obtained during an interview with Dr.Hertrich, DFVLR. Additional funding, at least 10 percent of each yearly total, is provided by the state governments.

[3]Industry receives from 80 to 90 percent of these funds, the remainder going to research organizations. The funds support the Civil Component Program and, to a lesser extent, Air Traffic Technology (e.g., DM 200,000 went to Air Traffic Technology out of the 1976 total; projections for 1978 are as high as DM 2 million out of a total of DM 16.7 million for this category.

Source: Bundeshaushaltsplan: Einzelplan 31, Geschäftsbereich des Bundesministers für Forschung und Technologie, 1976-1978.

TABLE 3-15

WEST GERMANY: PROJECTED FUNDING OF DEVELOPMENT FOR CIVIL AIRCRAFT PROGRAMS, 1974-1977

(DM Million, current)

	1963-73[1]	1974	1975	1976	1977
DEVELOPMENT					
A300 Airbus	635.8	191.0	126.0	185.0	51.7
VFW 614	230.9[2]	17.0	63.0	-	-
BO 105	42.9	-	-	-	-
Light Aircraft	10.0	5.0	8.0	5.0	-
Other Projects	82.7	-	-	-	41.3
Total (DM Million)	1002.3	213.0	197.0	190.0	93.0
($ Million)		82.9	81.2	75.4	40.0
EXPORT FINANCE AID					
A300 Airbus	-	4.0	12.0	22.0	40.0
VFW 614	-	2.0	3.0	10.0	18.0
PRODUCTION FINANCING					
A300 Airbus	-	25.0	62.0	105.0	199.0
TOTAL (DM Million)	1002.3	244.0	274.0	327.0	350.0
($ Million)		101.2	104.5	138.4	166.3

[1]Previous expenditures.

[2]Plus an additional DM 50 million in aid for Rolls-Royce M. 45H engine development.

Source: "The West German Aerospace Industry: An Agonizing Re-appraisal in Bonn," Interavia (July 1975), 776.

TABLE 3-16

WEST GERMANY: RECOMMENDED FUNDING FOR CONTINUATION OF AIRBUS AND VFW 614 PROGRAMS

(DM Million, current)

	1976-1980	1981-1985	1985-On	Total
AIRBUS PROGRAM				
Completion of current development work	200	-	-	200
Improvements to B2/B4 and development of freighter	80	-	-	80
Further development into an aircraft family	125	230	-	355
Marketing assistance				
Production	320	128	-	488
Sales	427	682	792	1901
Total funding	1152	1040	792	2984
Annual average funding	230	208	-	-
Withdrawals against state guarantees	-	600	500	1100
Annual average withdrawal	-	120	-	-
VFW 614 Program				
Additional powerplant costs	25	-	-	25
Further development of basic design	40	30	-	70
Marketing assistance				
Production	115	40	-	155
Sales	56	141	152	349
Total funding	236	211	152	599
Annual average funding	47	42	-	-
Withdrawals against state guarantees	-	-	150	150

Source: "The West German Aerospace Industry: State Control or Free Enterprise?" Interavia (April 1974), 317-318.

The VFW 614 recommendation was based on the fact that cancellation costs to the manufacturer could be as high as DM 150 million ($63.5 million), while total asset value was only about DM 77 million ($32.6 million).[17] The fear that termination would lead to a collapse of the VFW-Fokker firm foreshadowed the Government's rescue of the firm with a cash injection of $250 million in 1977 when the FVW project was cancelled.[18]

THE NETHERLANDS

The Government of the Netherlands provides funding for civil aircraft research and technology activities and contributes to the development costs of civil aircraft. Fokker-VFW constitutes the majority of the Netherlands' aerospace industry and, as such, is the primary commercial beneficiary of this support.[19] As in the other European countries, government aid for the development of commercial projects is rendered to reduce the commercial risks facing industry, and the government receives its return in the form of a sales royalty on each aircraft sold. In addition, the government will, in certain cases, guarantee commercial loans and make the interest payments on them to assist industry in launching a specific project.

The government provides most of its research, technology, and development funds through two agencies. The Netherlands Agency for Aerospace Programs (NIVR), funded by the Ministry of Economic Affairs, provides support for research and technology studies and programs in the area of civil aircraft airframes.[20] The National Research Laboratory (NLR), funded by the Ministry of Waterworks, conducts civil aircraft studies in the area of structures, materials, and equipment.

NLR is the primary research facility for civil aeronautics in the Netherlands. It also performs contract research for KLM airlines, Fokker-VFW, the Royal Dutch Airforce, and foreign firms. NIVR's resources for civil aircraft research are largely expended on contract research at NLR. Therefore, NLR receives government research funds in three ways:

- from direct appropriations
- from resources allocated to NIVR but spent on contract research at NLR
- from grants or loans to industry which are used for studies performed by NLR.

Total government expenditures for research and technology activities have increased in the 1974-1977 period, as indicated in Table 3-17. However, if total funding (including project development) is examined, government expenditures have been relatively constant during the period--approximately 47 million guilders ($20 million) per year.* This reflects the fact that no new major projects are currently receiving development funding from the government;[21] these resources have been transferred to research and technology activities, both for research (operations) and facilities construction (capital). Table 3-18 presents a disaggregation of capital expenditures as to their use. The funds allocated to NLR-Amsterdam have been relatively small and are not identified as to use from available sources. The expenditures for the large wind tunnel project represent the Netherlands' share of a joint program with Germany.

Expenditures for operations-type items are shown in Table 3-19. The major source of funding is from the Ministry of Waterworks and Transportation. Other government organizations provide from three to five million guilders ($1 million to $2 million) per year to NLR for research. At present, no civil aircraft are in commercial development under a government-supported program. Research for specific projects (e.g., F-28 Super), however, is still being funded in small amounts.

The portion of the NIVR budget devoted to civil aeronautic programs is not identified in any publicly-available document. Internal estimates of this portion were provided by the Director of Finance, NIVR, however. As can be seen, the amount has been estimated at about eight to ten million guilders ($3 million to $4 million) annually for the years 1974-1977. It was also determined that the operations budget will increase as the F-28 Super goes into development. However, capital needs will decrease upon completion of the wind-tunnel project.

The total development costs of the F-28 Super have been estimated to be about $400 million. Future orders and options are not expected to be sufficient to meet the development costs, and the firm would require the government to share in the risks before undertaking the project. Fokker-VFW has made

*The sum of total expenditures from Tables 3-18 and 3-19.

TABLE 3-17

NETHERLANDS: GOVERNMENT EXPENDITURES FOR RESEARCH AND TECHNOLOGY OF CIVIL AIRCRAFT AIRFRAMES AND ENGINES CAPITAL AND OPERATIONS, 1974-1977 (Guilders Millions, current)

Total Expenditures	1974	1975	1976	1977
Operations[1]	24.4	30.3	31.1	33.7
Capital	2.2	5.3	16.1	15.0
Total (Guilders Millions)	26.6	35.6	47.2	48.7
($ Millions)	10.6	13.2	19.2	21.4

[1]The portion of funds for aircraft development as shown in Figure 3-19 has been deducted so that only research and technology expenditures remain.

Source: Figures 3-18 and 3-19

TABLE 3-18

NETHERLANDS: GOVERNMENT EXPENDITURES FOR RESEARCH, TECHNOLOGY, AND DEVELOPMENT FOR CIVIL AIRCRAFT AIRFRAMES AND ENGINES CAPITAL EXPENDITURES, 1974-1977

(Guilders 000, current)

	1974	1975	1976	1977
Subsidy to NLR-Amsterdam for Investment in Facilities[1]	2200	4925	4220	4300
Subsidy to NLR for the Construction of a Large Wind Tunnel[2]	-	365	11910	10700
TOTAL (Guilders 000)	2200	5290	16130	15000
($ 000)	876	1968	6565	6585

[1] General Budget of the Government of the Netherlands, for the years 1974, 1975, 1976, 1977; Article 126.

[2] Ibid., Article 128.

TABLE 3-19

NETHERLANDS: GOVERNMENT EXPENDITURES FOR RESEARCH, TECHNOLOGY, AND DEVELOPMENT FOR CIVIL AIRCRAFT AIRFRAMES AND ENGINES OPERATIONS, 1974-1977

(Guilders 000, current)

	1974	1975	1976	1977
Participation in the cost of developing aircraft (Development)	22150	9500	-	-
National Research Laboratory (NLR)[2] Transport Budget	12576	18486	17436	18684
Research, Technology, and Development Support from other agencies	2905	3805	4640	4966
Nederlands Institutt Voor Vliegtingont-wikkeling en Ruimtevaart (NIVR)[3]	8000	8000	9000	10000
Totals (Guilders 000)	45631	39791	31076	33650
($ 000)	18201	14803	12648	14772

[1]General Budget of the Government of Netherlands: 1974, 1975, 1976, 1977; Article 89.

[2]Ibid., Article 121.

[3]Interview with financial officer and visual access to non-official sources at NIVR. The above figures are the section of the NIVR budget that can be identified as being for airframe and engine research.

public a financing plan whereby the Netherlands would lend the company $125 million and guarantee a bank loan of $155 million; thus the government would be responsible for seventy percent of the development costs.[22] The company also plans to add France as a partner for the F-28 Super in addition to West Germany and England who cooperated on the F-28.[23]

RESEARCH AND TECHNOLOGY EXPENDITURES

Europe

From the data for each country, it was possible to estimate that portion of government support which was used for civil airframe and engine research and technology expenditures. These results are shown in Figure 3-20. In each case, only operating expenditures, personnel costs, and administrative cost were counted; expenditures for construction of facilities were eliminated. Alos, joint civil-military expenditures were eliminated where the civil portion could not be identified. In the case of France, it is likely that this understates governmental support because the civil portion of ONERA expenditures could not be identified.

Thus, the data in Table 3-20 present a conservative estimate of Government support for civil airframe and engine research and Technology activities. It can be seen that Great Britain provided the highest level of support followed by France, West Germany and the Netherlands, respectively.

United States

The research and technology expenditures for the United States were obtained directly from NASA and the FAA. They are shown on Table 3-21.

TABLE 3-20

GOVERNMENT FINANCIAL SUPPORT FOR AERONAUTIC RESEARCH AND TECHNOLOGY IN FOUR EUROPEAN COUNTRIES

($ Millions: 1977)

	1974	1975	1976	1977	Average 1974-1977
United Kingdom[1]	41.0	36.4	29.8	34.1	35.3
France[2]	25.0	29.3	29.5	28.7	28.1
West Germany[3]	23.9	20.9	24.1	27.6	24.1
Netherlands[4]	11.8	12.6	13.4	14.8	13.2
Total	101.7	99.2	96.8	105.2	100.7

[1]Table 3-1, research and development expenditures only

[2]Table 3-6, excluding development expenditures

[3]Table 3-14, excluding facilities expenditures

[4]Table 3-17, excluding capital expenditures

TABLE 3-21

U.S. EXPENDITURES FOR CIVIL
AIRCRAFT AIRFRAME AND ENGINE RESEARCH AND
TECHNOLOGY 1974-1977

($ Millions: 1977 prices)

NASA Research and Technology Funding	1974	1975	1976	1977	Average 1974-1977
Civil Only	46.6	41.8	44.6	46.4	44.9
Civil Portion of Joint Civil-Military	97.4	87.2	93.2	94.7	93.1
Research and Program Management					
Civil Only	42.6	40.3	40.4	41.4	41.2
Civil Portion of Joint Civil-Military	89.0	84.5	84.4	83.6	85.4
Total NASA Expenditures	275.6	253.8	262.6	266.1	264.6
FAA					
Noise and Pollution	4.2	5.3	3.2	3.8	4.1
TOTAL	279.8	259.1	265.8	269.9	268.7

NOTES

[1]Supply Estimates, House of Commons (London HMSO) various years.

[2]See, for example: Appropriation Accounts, 1976-1977 Volume 2, House of Commons (London: HMSO), IV-15.

[3]Britain, Chancellor of the Exchequer, The Government's Expenditure Plans, 1978-1979 to 1981-1982, Vol. II.

[4]Ibid, p. 22, paragraph 16.

[5]Ibid., p. 22, paragraphs 17 and 18.

[6]Ibid., p. 22, paragraph 19.

[7]Ibid., pp. 110-111.

[8]Ibid., pp. 117-118.

[9]Budget Voté: Transports, III Aviation Civile. Paris: Imprimerie Nationale.

[10]Imprimerie Nationale. Project de Loi. Portant Réglèment Définitif du Budget de 1976. Section II, "Les Aides à la Construction Aéronatique," 97.

[11]Ministry for Research and Technology of the Federal Republic of Germany, Aeronautical Research and Technology: Overall Program of the Federal Government 1975-1978, (Bonn, Germany: DFVLR, 1976), 21.

[12]Ibid., p. 18.

[13]"West Germany's Aerospace Industry--Disillusioned with Europe," Interavia (May 1974), 429.

[14]"The West German Aerospace Industry: An Agonizing Reappraisal in Bonn," Interavia (July 1975), 773.

[15]"West Germany's Aerospace Industry--Disillusioned with Europe," 429.

[16]"The West German Aerospace Industry: State Control or Free Enterprise," Interavia (April 1976), 317.

[17]Ibid., p. 318.

[18]Ibid.

[19]"The European Aerospace Industry," Interavia (June 1977), 590.

[20]Interview with Finance Director, NIVR.

[21]Small amounts of loan guarantee funds have been spent for further development of the A300B, F-27 Maritime and F-28 aircraft. See: Verslag van de Werkzäamheden, Netherlands Institute Voor Vliegtuigontwikkeling en Ruimtevaart (Delft), 1974-1977. NIVR Annual Reports for the years 1974-1977.

[22]"Fokker Nears Decision on Super F-28," Aviation Week and Space Technology (September 4, 1978), 163.

[23]Ibid., p. 164.

IV. ANALYSIS OF RESEARCH AND TECHNOLOGY EXPENDITURE DATA

The data developed in Chapter 3 present the best estimate of government support in the four European countries and in the United States for airframe and engine research and technology. While the absolute value of the R&T expenditures is important, there is a need to look at the countries' expenditures on Research and Technology in relation to other factors -- not in a vacuum. All of the comparisons in Table 4-1 were made and evaluated with respect to the question of whether either the United States or the European countries in the aggregate are over-investing in R&T for the civil aeronautics sector. All of these measures attempt to check the proportionality of the expenditures. It appears that the best measures are those that relate investment to output of the industry, and industry output to a country's need for aviation. Throughout this Chapter, the term Europe will refer to the four countries: United Kingdom, France, West Germany and the Netherlands.

The R&T expenditures can be related to the size of the overall economy by using Gross Domestic Product (GDP). The results of this comparison, shown in Table 4-2, indicate that the U.S. provides about twice as much support as do the European Countries. However, this measure makes no allowance for size of the industry in Europe and U.S. If Europe's spending was eight times higher in relation to GDP than United States' spending, the

TABLE 4-1

COMPARISONS OF U. S. AND EUROPEAN R&T EXPENDITURES

	U. S.	Four European Countries
$\frac{\text{Average Annual CAAE R\&T}}{\text{Average Annual GDP}^1} \times 100$	0.02%	0.01%
$\frac{\text{Average Annual CAAE R\&T}}{\text{Average Annual Total Gov't R\&D}^2} \times 100$	1.22%	0.74%
$\frac{\text{Average Annual CAEE R\&T}}{\text{Average Annual Civil Aircraft Sales}} \times 100$	2.97%	3.70%
$\frac{\text{Average Annual CAAE R\&T}}{\text{Average Annual Total Airline Traffic}} \times 1000$	$1.20[3]	$1.50[3]
$\frac{\text{Average Annual Civil Aircraft Sales}}{\text{Average Annual Total Airline Traffic}} \times 1000$	$40.00[3]	$42.00[3]
$\frac{\text{Average Annual Civil Aircraft Sales}}{\text{Average Annual GDP}^1} \times 100$	0.50%	0.24%

[1]Gross Domestic Product (GDP)

[2]Research and Development (R&D)

[3]Dollars per thousand passenger kilometers

TABLE 4-2

RESEARCH AND TECHNOLOGY EXPENDITURES
GROSS DOMESTIC PRODUCT
(percent)

	1974	1975	1976	1977	Average Annual (1974-1977)
Europe	.009	.009	.008	.008	.008
United States	.016	.015	.015	.014	.015

figure might be impressive--but would it be meaningful? If Europe's civil aeronautics sector was eight times as large as the U.S. sector, then the higher funding level is explained. Therefore, looking only at R&T/GDP can be misleading.

If there were different levels of government commitment to research funding in general in the United States and Europe, this could explain the differences in the proportions of R&T funding to GDP. But in comparing the total research and development budgets to GDP, a very similar level of commitment to total R&D is noted for Europe and the United States (see Table 4-3). In otherwords, the R&T expenditure is not smaller for Europe because their overall government investment in R&D is smaller. The ratio of R&T in the civil aeronautics area to R&D shows the U.S. spending 1.6 times more that the Europeans (see Table 4-4). However, the industry size and the country's need for aviation are still not taken into account. Therefore, validity is lacking if one looks at this measure alone.

TABLE 4-3

RESEARCH AND DEVELOPMENT EXPENDITURES
GROSS DOMESTIC PRODUCT
(percent)

	1974	1975	1976	1977	Average Annual (1974-1977)
Europe	1.13	1.28	1.14	1.00	1.13
United States	1.24	1.25	1.22	1.27	1.24

TABLE 4-4

RESEARCH AND TECHNOLOGY EXPENDITURES
RESEARCH AND DEVELOPMENT EXPENDITURES
(percent)

	1974	1975	1976	1977	Average Annual (1974-1977)
Europe	.77	.69	.72	.78	.74
United States	1.32	1.23	1.21	1.13	1.22

The major shortcoming with the above comparisons is that they do not account for industry size. However, to be a truly valid measure, the size of a country's industry should be related to the need for air travel by a country. The question remains whether larger amounts of research and technology expenditures can be explained by a larger industry, or by a need for larger amounts of air travel.

The ratio of civil aircraft sales to GDP was used to control for industry size. This measure shows how important the civil aeronautics sector is to the economy; that is, the proportion of GDP (a measure of a nation's output) accounted for by the output (in sales dollars) of the civil sector. The United States industry proves to contribute twice as much to GDP as the industry does in the European countries (Table 4-5).

TABLE 4-5

CIVIL AEROSPACE SALES
GROSS DOMESTIC PRODUCT
(percent)

	1974	1975	1976	Average Annual (1974-1976)
Europe	.21	.26	.25	.24
United States	.58	.54	.49	.54

After controlling for industry size the two to one ratio of R&T expenditures to GDP is not disproportionate. The United States government provides twice as much support to their civil aeronautics sector as do the Europeans, and the sector is twice as important to the United States economy.

Government support of research and technology can be assessed in relation to industry sales, as an indicator of industry size, an investment to output ratio. The results of this comparison (Table 4-6) indicate that the four European countries provide proportionately more government research support to their civil aeronautics industry, once industry size is taken into account.

TABLE 4-6

RESEARCH AND TECHNOLOGY EXPENDITURES
CIVIL AEROSPACE SALES
(percent)

	1974	1975	1976	Average Annual (1974-1976)
Europe	4.1	3.4	3.3	3.6
United States	2.8	2.8	3.0	2.9

It is necessary to evaluate whether the industry size in each country is in propportion to the need for aviation of that country. The relationship between sales and airline traffic from each country (expressed in passenger (kilometers) is used to do this. Both domestic and international traffic have been included. Not to include international travel would create a serious underestimation of European civil aviation needs. Intra-European and international traffic account for the majority of European aviation needs. This is in direct contrast to the United States. Therefore, including the international passenger kilometers is the most conservative case as it rates the European need for aviation at the highest possible level.

The results of this comparison (Table 4-7) show that the United States and European dollars of aerospace sales per passenger kilometer flown are almost equal. Therefore, the output of the European industry and the

output of the United States industry are in the same proportion to their need for air transportation (passenger kilometers flown).

TABLE 4-7

CIVIL AEROSPACE SALES

TOTAL PASSENGER TRAFFIC
(in dollars per thousand passenger kilometers)

	1974	1975	1976	Average Annual (1974-1976)
Europe	47.8	46.3	42.7	44.0
United States	45.3	41.9	36.9	41.3

Comparing the government investment in R&T in proportion to passenger kilometers flown in the United States (Table 4-8), the United States investment proves to be slightly less than the European expenditure per passenger kilometer flown. Again, when the countries needs for aviation are considered, the R&T investments in both the United States and Europe are made in very similar proportions.

TABLE 4-8

RESEARCH AND TECHNOLOGY EXPENDITURES

TOTAL PASSENGER TRAFFIC
(in dollars per thousand passenger kilometers)

	1974	1975	1976	1977	Average Annual (1974-1977)
Europe	1.8	1.6	1.4	1.5	1.5
United States	1.3	1.2	1.1	1.1	1.2

The preceeding ratios and comparisons point to the conclusion that Europe and the United States are spending very close to the same amount for civil aeronautics R&T in proportion to their industry size and their need for aviation. One simple way to check this conclusion is to use the Kendall Co-

TABLE 4-9

KENDALL COEFFICIENT OF CONCORDANCE:
MEASUREMENT OF ASSOCIATION BETWEEN
R&T EXPENDITURES AND INDUSTRY SIZE VARIABLES

(Ranked Data)[1]

Measures (K)	Countries (N)				
	U.K.	France	West Germany	Netherlands	United States
Average Annual GDP	4	3	2	5	1
Average Annual Civil Sales	2	3	4	5	1
Average Annual Airline Passenger Kilometers	2	3	4	5	1
Average Annual Government R&D	4	3	2	5	1
Average Annual R&T Expenditures	2	3	4	5	1
Sum of Rankings	14	15	16	25	5

Mean Ranking: 15

Sum of Squared Deviations: $s = 202$

$$W = \frac{s}{\frac{1}{12} K^2 (N^3 - N)}$$

$$0.808 = \frac{242}{\frac{1}{12} (25) (120)}$$

[1]Data ranked from highest to lowest (1 to 5 respectively)

Sources: Tables 3-20, 3-21, A-2, A-3, A-4 and A-5.

efficient of Concordance (W).[1] This measures the degree of association among ranked variables. A very low measure of agreement would indicate that at least some countries had serious disparities between their R&T expenditures and other variables. The dollar amount of governmental R&T expenditures are ranked from highest to lowest (1 to 5) along with the other variables used above -- GDP, Government R&D, Civil Sales, and Airline Traffic -- as shown in Table 4-9. The correlation between the rankings of each measure for each country is then calculated. The results of the analysis indicate a measure of agreement of 80% (perfect agreement would be equal to one). A high degree of proportionality between countries in confirmed by this test.

SUMMARY

The data presented in this report indicate that the estimated total contribution to civil aircraft airframe and engine R&T of the four European countries has averaged $100.9 million per year (at 1977 prices) for the 1974-1977 period. During the same period, United States expenditures averaged $268.7 million per year (at 1977 prices). However, when the scale of industry activity in each country is put into perspective, and when the need for civil aviation is accounted for, R&T expenditures for the United States and Europe are proportional.

NOTES

[1]Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill, 1956), pp. 229-239.

V. CONCLUSIONS

Upon completion of the research and analysis concerning United States' and European government expenditures, the following conclusions can be drawn:

- In absolute terms during the period 1974-77 the United States government contributed 2.7 times more dollars for civil aircraft airframe and engine R&T than the combined total for the four European countries.

- When the size of the aeronautics industry in the United States and Europe is put into perspective, and the need for civil aviation is accounted for, government expenditures on civil aircraft airframe and engine R&T in the United States and Europe are not disproportionate.

APPENDIX A

DATA ASSUMPTIONS AND LIMITATIONS

Much of the expenditure data for the four European countries examined in this report was developed by Gellman Research Inc. and INSPEC during the month of June 1978. Other European data were researched by ORI, Inc., in December 1979. The United States expenditure data was compiled by ORI, Inc. using information provided by NASA and the FAA.

The major limitations to the data base, and the approaches used to overcome these, are outlined below:

- As per NASA requirements, expenditure data was developed for a four year period, 1974-1977; thus, time series analysis are not appropriate. Trends in the expenditure patterns for each country cannot be identified in a meaningful way. Therefore, average annual expenditures for the 1974-1977 period in each country are used to compare expenditure levels to minimize the effects fluctuating yearly government support on the results of the analysis.
- Other measures of the activity levels of the U.S. and European aerospace industry (besides the sales figures) are not available on a comparable basis for each country. Therefore, some desirable measures of comparison (e.g. export data) are not included in this report.

- Although every effort was made to avoid including government expenditures for research and technology in the avionics area, it is possible that small amounts of funding for this activity remain in the data base. NASA has indicated that this may also be the case for the U.S. R&T expenditure data which it developed for use in this report.

- Since the European data was extracted from the expenditure records of the European countries, the data may underestimate European R&T spending, but are extremely unlikely to overestimate their expenditures. For example, some of the French government funding for ONERA probably was not counted. The U.S. data was provided directly from the United States agencies involved, and are, therefore, considered to be more accurate.

- Expenditures reported in foreign currencies were converted to a U.S. dollar basis for the year in which they were made, as shown in Chapter 3. All expenditures were then converted to 1977 U.S. price levels for the development of average annual expenditures. The factors used for currency conversion and price level restatement are presented in Table A-1 of the appendix.

APPENDIX B

TABLE B-1

CONVERSION FACTORS USED

EXCHANGE RATE: NATIONAL CURRENCY TO U.S. DOLLARS[1]

	1974	1975	1976	1977
England (£)	2.349	2.024	1.702	1.906
France (FF)	0.225	0.223	0.201	0.213
Germany (DM)	0.415	0.381	0.423	0.475
Netherlands (Guilders)	0.399	0.372	0.407	0.439

U.S. GNP IMPLICIT PRICE DEFLATOR (1977 DOLLARS)[2]

1974	1.214
1975	1.111
1976	1.055
1977	1

[1]Source: OECD, Main Economic Indicators, August 1978

[2]Sources: Adapted from: 1974 Statistical Abstract of the United States, U.S. Department of Commerce, 1977

1975-77, Survey of Current Business, U.S. Department of Commerce, June 1978

TABLE B-2

UNITED STATES AND FOUR EUROPEAN COUNTRIES'
ESTIMATED CIVIL AEROSPACE
SALES 1974-1976
($ Millions: 1977 Prices)

	1974	1975	1976	Average 1974-1976
United Kingdom	1194	1316	1209	1240
France	819	1007	1118	981
West Germany	281	282	289	284
Netherlands	184	281	297	254
Total: Four European Countries	2478	2886	2913	2759
United States:	9914	9169	8871	9318

Source: Estimated from data presented in: Commission of The European Communities, The European Aerospace Industry: Trading Position and Figures, (various years)

TABLE B-3

TOTAL AIRLINE TRAFFIC[1] U.S. AND FOUR EUROPEAN COUNTRIES 1974-1977

(Billions of Passenger Kilometers)

	1974	1975	1976	1977	Average 1974-1977
United Kingdom	21.17	23.14	25.79	25.65	24.17
France	18.11	19.39	20.99	22.74	20.31
West Germany	10.39	11.26	12.49	13.25	11.87
Netherlands	7.81	8.44	8.86	9.52	8.66
Total: Four European Countries	57.48	62.33	68.13	72.07	65.00
United States:	218.50	218.45	240.02	256.39	233.22

[1]Domestic and International

Source: United Nations Monthly Bulletin of Statistics Vol. XXXII, September 1978

TABLE B-4

GROSS DOMESTIC PRODUCT IN THE UNIED STATES
AND FOUR EUROPEAN COUNTRIES: 1974-1977

($ Billions: 1977 Prices)

	1974	1975	1976	1977	Average 1974-1977
United Kingdom	233.5	231.8	223.6	267.0	239.0
France	342.9	356.4	351.8	398.4	362.4
West Germany	497.5	436.4	501.5	569.3	501.2
Netherlands	92.1	86.3	101.6	114.6	98.7
Total: Four European Countries	1166.0	1110.9	1178.5	1349.3	1201.3
United States	1708.1	1695.4	1795.6	1879.0	1769.5

Source: United Nations Monthly Bulletin of Statistics, Volume XXXII, September 1978

TABLE B-5

TOTAL GOVERNMENT R&D EXPENDITURES
($ Millions: 1977 Prices)

	1974	1975	1976	1977	Average
United Kingdom	3052.5	3260.5	3107.7	2899.5	3080.1
France	3783.6	4370.5	3891.1	4026.5	4017.9
West Germany	5592.7	5754.8	5470.2	5514.4	5583.0
Netherlands	770.8	887.6	943.6	1029.2	907.8
Total: Four European Countries	13199.6	14273.4	13412.6	13469.6	13588.8
United States	21141.4	21123.7	21900.3	23825.0	21997.6

Sources: European data - Government Financing of Research and Development, 1970-1978, Statistical Office of the European Communities

U.S. data - President's Budgets FY 1978 and 1979, Special Analysis "P"

END

DATE

FILMED

FEB 22 1983

3 1176 00134 3541